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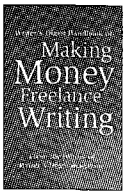

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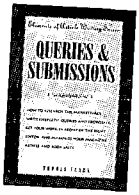

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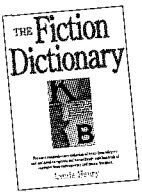

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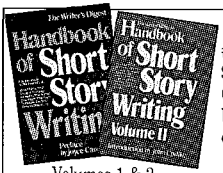

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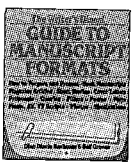

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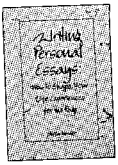

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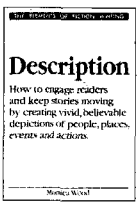
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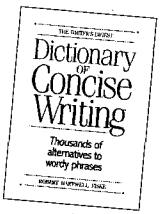

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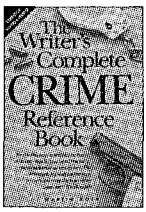

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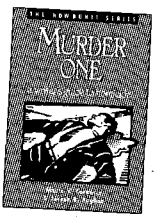

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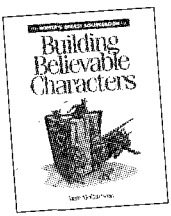

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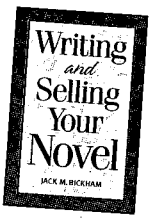

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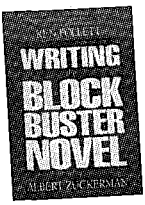

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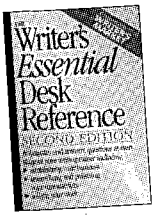

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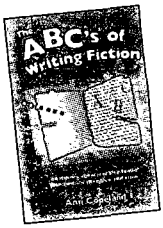

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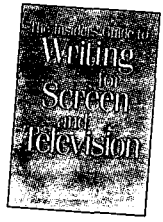

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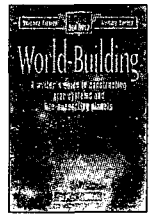

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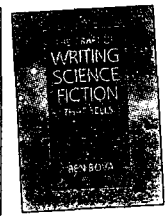

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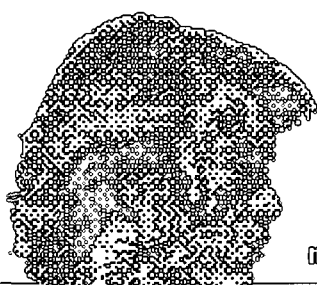

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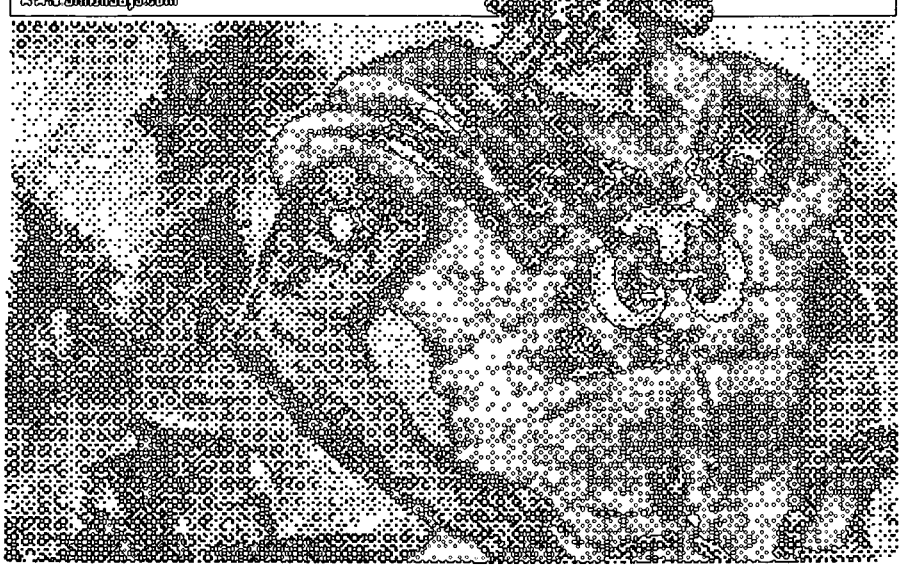

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EDITORIAL Stanley Schmidt

ASTEROIDS AND LOTTERIES

Statistical analysis is a useful decision-making tool in a wide range of applications. Physicists use it to model the macroscopic behavior of systems too complicated to keep track of the microscopic behavior of all the constituent particles, like gases. Insurance agents use it to determine how much they must charge their clients to cover claims and still make a profit.

But there are times when simple statistical analysis is not enough. In particular, there's a whole class of situations involving events with very low probabilities but very large consequences. In those, sometimes a course of action may make significant sense even when a simple consideration of likelihood of occurrence, or likely gain or loss, says it doesn't. Even if an event is quite unlikely to produce *any* damage or reward, a sensible person (or organization) who can afford it might reasonably make a small investment in trying to win an unlikely but potentially *huge* payoff, or to insure that an unlikely but potentially huge catastrophe never happens.

I was reminded of this recently in a discussion with a group of scientists who were trying to determine major problems the country (and the world) might face in the next few decades, so they could start thinking about solutions. One kind of threat that was brought up was that of a good-sized asteroid or comet colliding with the Earth. We know that this has happened in the past, and that it will surely happen again. We also know that it can do a tremendous amount of damage. (One of the first attempts to estimate just *how much* damage appeared right here in *Analog,* in J. E. Enever's March 1966 article "Giant Meteor Impact.") Such an event is now widely considered the most probable cause of the extinction of the dinosaurs, and likely other big die-offs before that.

However, we also know that it doesn't happen very often. *Little* meteors hit us every day; most of them burn up, completely or almost, in the atmosphere, and so do little or no harm at the surface. The kind that cause mass extinctions seem to come at intervals of millions of years. Even the smaller ones that would devastate mere cities are probably, on average, centuries apart. Few, if any, of us have ever known anybody hurt by a meteorite impact, and most of us probably never will. So how much effort, if any, should go into identifying potentially threatening objects, or building defenses against them?

To some of us it seemed that, in view of the tremendous amount of damage that *can* be done by this type of impact, and the fact that they can't be predicted like clockwork with our present knowledge, it would be worth at least trying to catalog whatever is out there, plot their orbits, and determine whether any of them pose enough of a threat to warrant defensive measures—particularly since, given enough advance warning, such defenses could be relatively inexpensive, by national security standards. Others said they had already looked at this

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question, in consultation with people who had studied it intensively, and decided that it would not be a worthwhile use of their resources. Those studies had estimated that the chance of any person's dying from a meteorite impact is about the same as that of dying from a plane crash. And no one would suggest that preventing one more plane crash is a major problem of national security.

But the comparison is not valid. The claim may be true, but the plane has no chance of killing everybody on the planet, or even in a city, while the asteroid does. If we are thinking far enough beyond individual lives and actuarial tables to care about the survival of our species and civilization—which a *lot* of lives and effort have gone into building—that should make a difference. Sure, the average risk to an individual is minuscule—but the category of events includes some of the few we can imagine with a real, even if small, possibility of killing *all* of us.

Admittedly there would be little point in learning of such a threat if there were no chance of doing anything about it, but that's not the case. It's quite feasible, with existing space technology, to concoct ways of deflecting an object bearing down on us enough to make it miss. It's even easier, and cheaper, just to systematically collect information, so we'd *know* whether there is anything out there that warrants building a defense system. (It might be preferable to do that first anyway, despite the very slight risk of finding a threat so imminent that we don't have time to avert it. Equipment that can deflect an asteroid big enough to be a planetary threat could just as easily be turned on other humans. Unless we *know* that it's needed, its existence would probably pose a greater danger than maybe-asteroids.)

Similar considerations can apply to potentially beneficial events. A typical state lottery, for example, is one of the lousiest imaginable investments, if analyzed in terms of probable return on investment, or even the likelihood of winning *anything*. The vast majority of lottery ticket purchases are, purely and simply, money down the drain; they will never return a penny to their purchasers. I haven't calculated the average total lifetime winnings by a lottery purchaser, but I doubt that they're even enough to buy another lottery ticket. Such indisputable facts are commonly regarded as proving the sheer folly of anyone's ever buying a lottery ticket.

And yet . . .

The fact remains that a very few people do win enough money from a lottery to enable them to retire very comfortably at a very early age. Certainly it makes no sense for anyone to spend a large fraction of his or her income on lottery tickets in the belief that that's the best way to insure a comfortable retirement. And, sadly, that does happen. I've often seen senior citizens, most of them probably already retired on fixed and limited incomes, standing at a counter

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buying dozens of lottery tickets, carefully selecting each one individually as if their choices actually made any difference. What such people are spending on this astronomically long shot is almost certainly adversely affecting their standard of living, and is highly unlikely ever to produce any benefits whatsoever.

But now consider a quite different case: a person, say, 30 or 40 years old, making a reasonably comfortable living in a job which he doesn't particularly enjoy but can't expect to retire from for another 30 or 40 years. Such a person may know lots of things he'd rather be doing, and would like to get started on as soon as possible. Buying an occasional lottery ticket, even one or two every week, will make no significant difference in his current lifestyle or projected date of retirement. But *winning* a lottery could effect an instant, enormous, radical transformation, by making financial independence possible immediately—and decades before it could otherwise be expected. For such a person, the lottery *does* make sense, as long as he understands that it's basically just a game, with the odds very strongly against him, rather than a serious investment strategy. For many such people, it may be the only thing they can do that offers even a trivially nonzero chance of instant retirement—and even a minuscule chance of such a huge payoff may well be worth a trivial investment.

The key concept here is that the investment is too small for its loss to have a significant impact on present or future life. That's just as true whether you're talking about gambling a pittance for the remote chance of suddenly getting control of your own finances, or guarding against an unlikely but enormous catastrophe. Certainly nobody on a meager income should be spending much, if any, of it on lottery tickets. Nor should a society that's barely keeping its members alive be putting much, if anything, into searching for an asteroid that *might* hit sometime in the next few million years. It can't afford to; it has too many higher-probability, higher-urgency problems.

But a person who's living comfortably enough to think about even small luxuries *can* afford the occasional lottery ticket; and, depending on his or her priorities, it may be as worthwhile a purchase as many others he could make. Surely it's as sensible as a pack of chewing gum, particularly if the person is more interested in even a slight chance

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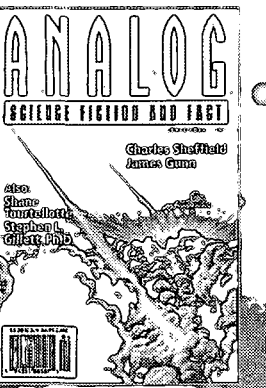

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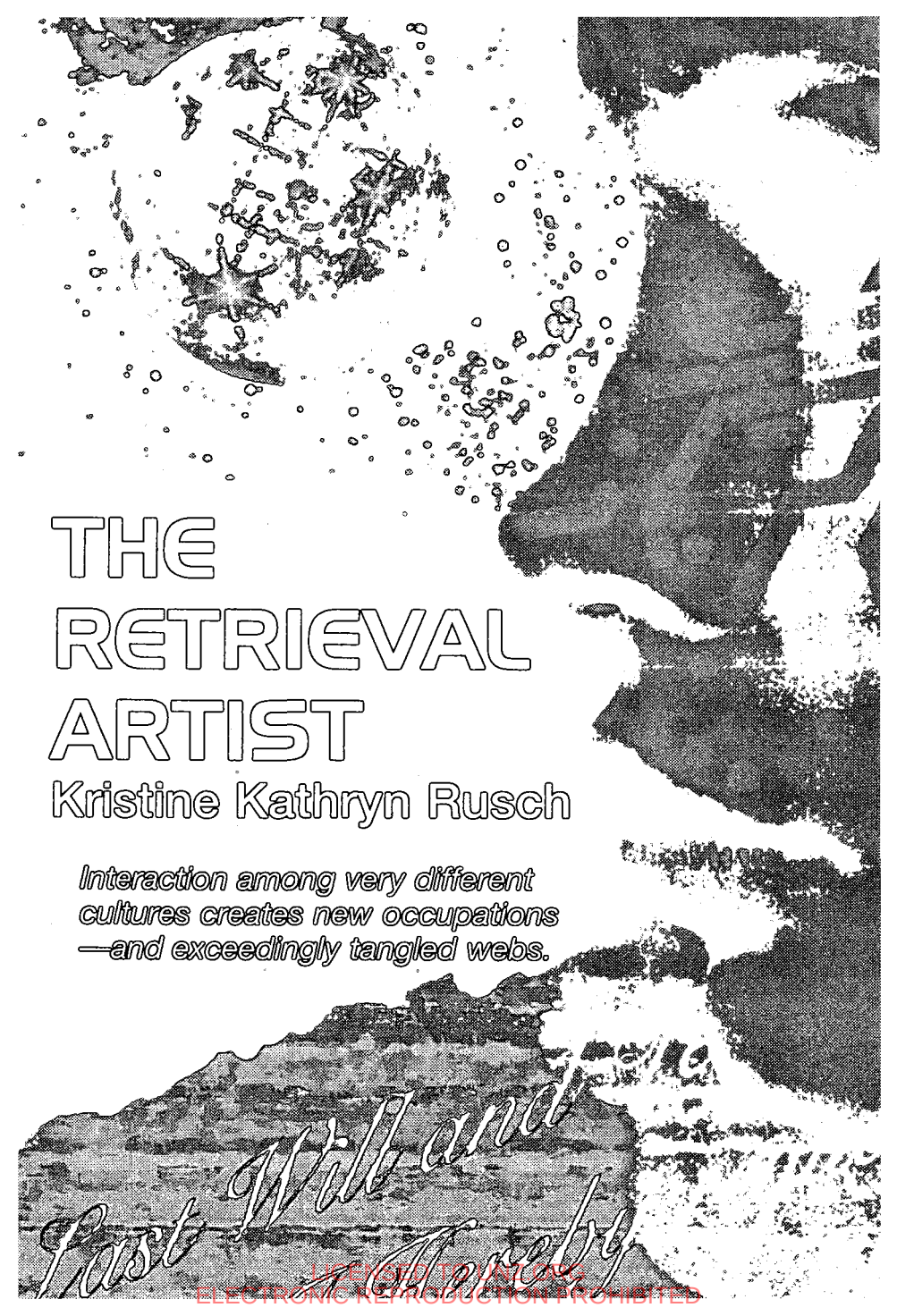

THE RETRIEVAL ARTIST

Kristine Kathryn Rusch

Interaction among very different cultures creates new occupations —and exceedingly tangled webs.

Past Tense

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I

I had just come off a difficult case, and the last thing I wanted was another client. To be honest, not wanting another client is a constant state for me. Miles Flint, the reluctant Retrieval Artist. I work harder than anyone else in the business at discouraging my clients from seeking out the Disappeared. Sometimes the discouragement fails and I get paid a lot of money for putting a lot of lives in danger, and maybe, just maybe, bringing someone home who wants to come. Those are the moments I live for, the moments when it becomes clear to a Disappeared that home is a safe place once more.

Usually, though, my clients and their lost ones are more trouble than they're worth. Usually, I won't take their cases for any price, no matter how high.

I do everything I can to prevent client contact from the start. The clients who approach me are the courageous ones or the really desperate ones or the ones who want to use me to further their own ends.

I try not to take my cases personally. My clients and their lost ones depend on my objectivity. But every once in a while, a case slips under my defenses—and never in the way I expect.

This was one of those cases. And it haunts me still.

II

My office is one of the ugliest dives on the Moon. I found an original building still made of colonial permaplastic in the oldest section of Armstrong, the Moon's oldest colony. The dome here is also made of permaplastic, the clear kind, although time and wear have turned it opaque. Dirt covers the dome near the street level. The filtration system tries to clean as best it can, but ever since some well-meaning dome governor pulled the permaplastic flooring and forgot to replace it, this part of Armstrong Dome has had a dust problem. The filtration systems have been upgraded twice in my lifetime, and rebuilt at least three times since the original settlement, but they still function at one-tenth the level of the state-of-the-art systems in colonies like Gagarin Dome and Glenn Station. Terrans newly off the shuttle rarely come to this part of Armstrong; the high-speed trains don't run here, and the unpaved streets strike most Terrans as unsanitary, which they probably are.

The building that houses my office had been the original retail center of Armstrong, or so says the bronze plaque that someone had attached to the plastic between my door and the rent-a-lawyer's beside me. We are a historic building, not that anyone seems to care, and rent-a-lawyer once talked to me about getting the designation changed so that we could upgrade the facilities.

I didn't tell him that if the designation changed, I would move.

You see, I like the seedy look, the way my door hangs slightly crooked in its frame. It's deceptive. A careless Tracker would think I'm broke, or equally careless. Most folks don't guess that the security in my little eight-by-eight cube is state-of-the-art. They walk in, and they see permaplastic, and a desk that cants slightly to the right, and only one chair behind it. They don't see the recessed doors that hide my storage in the wall between the rent-a-lawyer's cube and my own, and they don't see the electronics because they aren't looking for them.

I like to keep the office empty. I own an apartment in one of Armstrong's better neighborhoods. There I keep all the things I don't care about. Things I do care about stay in my ship, a customized space yacht named *The Emmeline*. She's my only friend and I treat her like a lover. She's saved my life more times than I care to think about, and for that (and a few other things), she deserves only the best.

I can afford to give her the best, and I don't need any more work, although, as

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I said, I sometimes take it. The cases that catch me are usually the ones that catch me in my Sir Galahad fantasy—the one where I see myself as a rescuer of all things worthy of rescue—although I've been known to take cases for other reasons.

But, as I'd said, I'd just come off a difficult case, and the last thing I needed was another client. Especially one as young and innocent as this one appeared to be.

She showed up at my door wearing a dress, which no one wears in this part of Armstrong anymore, and regular shoes, which had to have been painful to walk in. She also had a personal items bag around her wrist, which, in this part of town, was like wearing a giant *Mug Me!* sign. The bags were issued on shuttles and only to passengers who had no idea about the luggage limitations.

She was tall and raw-boned, but slender, as if diet and exercise had reduced her natural tendency toward lushness. Her dress, an open and inexpensive weave, accented her figure in an almost unconscious way. Her features were strong and bold, her eyes dark, and her hair even darker.

My alarm system warned me she was outside, staring at the door or the plaque or both. A small screen popped up on my desk revealing her and the street beyond. I shut off the door alarm and waited until she knocked. Her clutched fist, adorned with computer and security enhancements that winked like diamonds in the dome's fake daylight, rapped softly on the permaplastic. The daintiness of the movement startled me. I wouldn't have thought her a dainty woman.

I had been cleaning up the final reports, notations, and billings from the last case. I closed the file and the keyboard (I never use voice commands for work in my office—too easily overheard) folded itself into the desk. Then I leaned back in the chair, and waited.

She knocked three times before she tried the door. It opened, just like it had been programmed to do in instances like this.

"Mr. Flint?" Her voice was soft, her English tinted with a faintly Northern European accent.

I still didn't say anything. She had the right building and the right name. I would wait to see if she was the right kind of client.

She squinted at me. I was never what clients expected. They expected a man as seedy as the office, maybe one or two unrepaired scars, a face toughened by a hard life and space travel. Even though I was thirty-five, I still had a look some cultures called angelic: blond curls, blue eyes, a round and cherubic face. A client once told me I looked like the pre-Raphaelite paintings of Cupid. I had smiled at him and said, *Only when I want to.*

"Are you Mr. Flint?" The girl stepped inside, then slapped her left hand over the enhancements on her right. She looked faintly startled, as if someone had shouted in her ear.

Actually, my security system had cut in. Those enhancements linked her to someone or something outside herself, and my system automatically severed such links, even if they had been billed as unseverable.

"You want to stay in here," I said, "you stay in here alone. No recording, no viewing, and no off-site monitoring."

She swallowed, and took another step inside. She was playing at being timid. The real timid ones, severed from their security blankets, bolt.

"What do you want?" I asked.

She flinched, and took another step forward. "I understand that you . . . find . . . people."

"Where did you hear that?"

"I was told in New York." One more step and she was standing in front of my desk. She smelled faintly of lavender soap mixed with nervous sweat. She must have come here directly from the shuttle. A woman with a mission, then.

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"New York?" I asked as if I'd never heard of it.

"New York City."

I had several contacts in New York, and a handful of former clients. Anyone could have told her, although none were supposed to. They always did though; they always saw their own desperation in another's eyes, figured it was time to help, time to give back whatever it was they felt they had gained.

I sighed. "Close the door."

She licked her lips—the dye on them was either waterproof or permanent—and then walked back to the door. She looked into the street as if she would find help there, then gently pushed the door closed.

I felt a faint hum through my wrist as my computer notified me that it had turned the door security back on.

"What do you want?" I asked before she turned around.

"My mother," she said. "She's—"

"That's enough." I kept my tone harsh, and I didn't stand. I didn't want this girl/woman to be too comfortable. It was always best to keep potential clients off balance.

Children, young adults, and the elderly were the obvious choices of someone trying to use my system for the wrong purposes, and yet they were the ones most likely to contact me. They never seemed to understand the hostility I had to show clients, the insistence I put on identity checks, and they always balked at the cost. *It feels as if I'm on trial, Mr. Flint,* they would say, and I wouldn't respond. They were. They had to be. I always had to be sure they were only acting on their own interests. It was too easy for a Tracker to hire someone to play off a Retrieval Artist's sympathies, and initiate a search that would get the Disappeared killed—or worse.

The girl turned. Her body was so rigid that it looked as if I could break her in half.

"I don't find people," I said. "I uncover them. There's a vast difference. If you don't understand that, then you don't belong here."

That line usually caused half my potential clients to exit. The next line usually made most of the remaining fifty percent excuse themselves, never to darken my door again.

"I charge a minimum of two million credits, Moon issue, not Earth issue—" which meant that they were worth triple what she was used to paying "—and I can charge as much as ten million or more. There is no upper limit on my costs nor is there one on my charges. I charge by the day, with expenses added in. Some investigations take a week, some take five years. You would be my exclusive employer for the period of time it takes to find your—mother—or whomever I'd be looking for. I have a contract. Several of my former clients have tried to have the courts nullify it. It holds up beautifully. I do not take charity cases, no matter what your sob story is, and I do not allow anyone to defer payment. The minute the money stops, so do I."

She threaded her fingers together. Her personal items bag bumped against her hip as she did so. "I'd heard about your financial requirements." Which meant that one of my former clients had recommended me to her. Dammit. "I have limited funds, but I can afford a minor investigation."

I stood. "We're done talking. Sorry I can't help you." I walked past her and pulled open the door. Security didn't mind if I did that. It would have minded if she had.

"Can't you do a limited search, Mr. Flint?" Her eyes were wide and brown. If she was twenty, she was older than I thought. I checked for tears. There were none. She could be legit, and for that I was sorry.

I closed the door so hard the plastic office shook. "Here's what you're asking me," I said. "If the money runs out, I quit searching, which is no skin off my nose. But I'll have dug a trail up to that

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particular point, and your mother—or whomever I'm looking for—"

She flinched again as I said that. A tender one. Or a good actress.

"—would be at more of a risk than she is now. Right now, she's simply disappeared. And since you've come to me, you've done enough research to know that one of six government programs—or one of fifteen private corporations—have gone to considerable expense to give her a new life somewhere else. If the cover on that existence gets blown, your mother dies. It's that simple. And maybe, just maybe, the people who helped her will die too, or the people who are now important to her, or the people who were hidden with her, for whatever reason. Half an investigation is a death sentence. Hell, sometimes a full investigation is a death sentence. So I don't do this work on whim, and I certainly don't do it in a limited fashion. Are we clear?"

She nodded, just once, a rabbit-like movement that let me know I'd connected.

"Good," I said and pulled the door back open. "Now get out."

She scurried past me as if she thought I might physically assault her, and then she hurried down the street. The moon dust rose around her, clinging to her legs and her impractical dress, leaving a trail behind her that was so visible, it looked as if someone were marking her as a future target.

I closed the door, had the security system take her prints and DNA sample off the jamb just in case I needed to identify her someday, and then tried not to think of her again.

It wouldn't be easy. Clients were rare, and if they were legit, they always had an agenda. By the time they found me, they were desperate, and there was still a part of me that was human enough to feel sympathy for that.

Sympathy is rare among Retrieval Artists. Most Retrieval Artists got into this line of work because they owed a favor to the Disty, a group of aliens who'd more or less taken over Mars. Others got into it because they had discovered, by accident, that they were good at it, usually making that discovery in their jobs for human corporations or human crime syndicates.

I got in through a different kind of accident. Once I'd been a space cop assigned to Moon Sector. A lot of the Disappeared come through here on their way to new lives, and over time, I found myself working against the clock, trying to save people I'd never met from the people they were hiding from. The space police frowned on the work—the Disappeared are often reformed criminals and not worth the time, at least according to the Moon Sector—and so, after one of the most horrible incidents of my life, I went into business on my own.

I'm at the top of my profession, rich beyond all measure, and usually content with that. I chose not to have a spouse or children, and my family is long dead, which I actually consider to be a good thing. Families in this business are a liability. So are close friends. Anyone who can be broken to force you to talk. I don't mind being alone.

But I do hate being manipulated, and I hate even more taking revenge, mine or anyone else's. I vigilantly protect myself against both of those things.

And this was the first time I failed.

III

After the girl left, I stayed away from the office for two days. Sometimes snubbed clients come back. They tell me their stories, the reasons they're searching for their parent/child/spouse, and they expect me to understand. Sometimes they claim they've found more money. Sometimes they simply try to cry on my shoulder, believing I will sympathize.

Once upon a time maybe I would have. But Sir Galahad has calluses growing on his heart. I am beginning to hate the individuals. They always take a level

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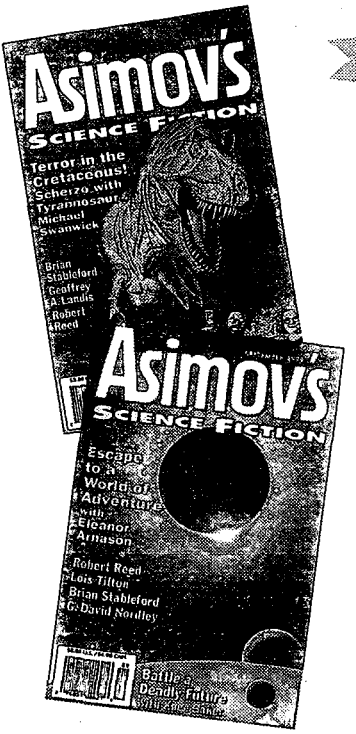

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of judgment that drains me. The lawyers trying to find a long-lost soul to meet the terms of a will; the insurance agents, required by law to find the beneficiaries, forced by the government to search "as far as humanly possible without spending the benefits"; the detective, using government funds to find the one person who could put a career criminal, serial killer, or child molester, away for life; these people are the clients I like the most. Almost all are repeat customers. I still have to do background checks, but I have my gut to rely on as well. With individuals, I can never go by gut, and even armed with information, I've been burned.

I've gotten to the point where coldness is the way of the game for me, at least at first. Once I sign on, I become the most intense defender of the Disappeared. The object of my search also becomes the person I protect and care about the most. It takes a lot of effort to maintain that caring, and even more to manage the protection.

Sometimes I'll go to extremes.

Sometimes I have no other choice.

On the third day, I went back to my office, and of course, the girl was waiting. This time she was dressed appropriately, a pair of boots, cargo pants that cinched at the ankles, and a shirt the color of sand. Her personal items bag was gone—obviously someone, probably the maître d' at the exclusive hotel she was most likely staying at, had told her it made her a mark for pickpockets and other thieves. Thin mesh gloves covered her enhancements. Only her long hair marked her as a newcomer. If she stayed longer than a month, she'd cut it off just like the rest of us rather than worry about keeping it clean.

She was leaning against my locked door, her booted feet sticking into the street. In that outfit, she looked strong and healthy, as if she were hiring me to take her on one of those expeditions outside the dome. The rent-a-lawyer next door, newly out of Armstrong Law, was eyeing her out of his scarred plastic window, a sour expression on his thin face. He probably thought she was scaring away business.

I stopped in the middle of the street. It was hot and airless as usual. There was no wind in the dome, of course, and the recycled air got stale real fast. Half the equipment in this part of town had been on the fritz for the last week, and the air here wasn't just stale, it was thin and damn near rancid. I hated breathing bad air. The shallow breaths and the increased heartbeat made me feel as if there was danger around when there probably wasn't. If the air got any thinner, I'd have to start worrying about my clarity of thought.

She saw me when I was still several meters from the place. She stood, brushed the dust off her pants, and watched me. I pretended as if I were undecided about my next move, even though I knew I'd have to confront her sooner or later. Her kind only went away when chased.

"I'm sorry," she said as I approached. "I was told that you expected negotiation, so I—"

"Lied about the money, did you?" I asked, knowing she was lying now too. If she knew enough to find me, she also knew that I didn't negotiate. All the lie proved was that she had an ego big enough to believe that the rules were different for her.

I shoved past her to use my palm to unlock the door. I only used a palm scan when someone else was present. It let us in, but initiated a higher level of security monitoring.

She started to follow me, but I slammed the door in her face. Then I went to my desk, and switched on my own automatic air. It was illegal, and it wouldn't be enough, but I wasn't planning to stay long. I would finish the reports from the last case, get the final fees, and then maybe I'd take a vacation. I had never taken one before. It was past time.

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I wish, now, that I had listened to my gut and gone. But there was just enough of Sir Galahad left in me to make me watch the door. And of course, it opened just like I expected it to.

She came inside, a little downtrodden but not defeated. Her kind seldom were. "My name is Anetka Sobol," she said as if I should know it. I didn't. "I really do need your help."

"You should have thought of that before," I said. "This isn't a game."

"I'm not trying to play one."

"So what was that attempt at negotiation?"

She shook her head. "My source—"

"Who is your source?"

"He said I wasn't—"

"Who is it?"

Again she licked that lower lip just like she had the day before, a movement that was too unconscious to be planned. The nervousness, then, wasn't feigned. "Norris Gonnot."

Gonnot. Sobol was the third client he'd sent to me in the last year. The other two checked out, and both cases had been easy to solve. But he was making himself too visible, and I would have to deal with that, even though I hated to do so. He was extremely grateful that I had found his daughter and granddaughter alive (although they hadn't appreciated it), and he'd been even more grateful when I was able to prove that the Disty were no longer looking for them.

"And how did you find him?"

She frowned. "Does it matter?"

I leaned back in my chair. It squeaked and the sound made her jump ever so slightly. "Either you're up front with me now or the conversation ends."

The frown grew deeper, and she clutched her left wrist with her right hand, holding the whole mess against her stomach. The gesture looked calculated. "Do you treat everyone like this?"

"Nope. Some people I treat worse."

"Then how do you get any work?"

I shrugged. "Just lucky."

She stared at me for a moment. Then she glanced at the door. Was she letting her thoughts be that visible on purpose or was she again acting for my benefit? I wasn't sure.

"A cop told me about him. Norris, that is." She sounded reluctant. "I wasn't supposed to tell you."

"Of course not. Gonnot wasn't supposed to talk to anyone. This cop, was he a rent-a-cop, a real cop, a Federal cop, or with the Earth Force?"

"She," she said.

"Okay," I said. "Was she a—"

"She was a New York City police officer who had her own detective agency."

"That's illegal in New York."

She shrugged. "So?"

I closed my eyes. Ethics had disappeared everywhere. "You hired her?"

"She was my fifth private detective. Most would work for a week and then quit when they realized that searching for an interstellar Disappeared is a lot harder than finding a missing person."

I waited. I'd heard that sob story before. Most detectives kept the case and simply came to someone like me.

"Of course," she said, "my father's looming presence doesn't help either."

"Your father?"

She was staring at me as if I had just asked her what God was.

"I'm Anetka Sobol," she said as if that clarified everything.

"And I'm Miles Flint. My name doesn't tell you a damn thing about my father."

"My father is the founding partner of the Third Dynasty."

I had to work to hide my surprise. I knew what the Third Dynasty was, but I didn't know the names of its founders. The Dynasty itself was a formidable presence all over the galaxy. It was a megacorp with its fingers in a lot of pies, mostly to do with space exploration, establishing colonies in mineral-rich areas, and exploitation of new resources. My contacts with the Third Dynasty weren't on the exploration level, but within its narrow interior holdings. The Third Dynasty was the parent company for Priva-

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cy Unlimited, one of the services which helped people disappear.

Privacy Unlimited had been developed, as so many of the corporate disappearance programs had, when humans discovered the Disty, and realized that in some alien cultures, there was no such word as forgiveness. The Disty were the harshest of our allies. The Revs, the Wygnin, and the Fuetrer also targeted certain humans, and our treaties with these groups allowed the targeting if the aliens could show cause.

The balance was a delicate one, allowing them their cultural traditions while protecting our own. Showing cause had to happen before one of eighteen multicultural tribunals, and if one of those tribunals ruled in the aliens' favor, the humans involved were as good as dead. We looked the other way most of the time. Most of the lives involved were, according to our government, trivial ones. But of course, those people whose lives had been deemed trivial didn't feel that way, and that was when the disappearance services cropped up. If a person disappeared and could not be found, most alien groups kept an outstanding warrant, but stopped searching.

The Disty never did.

And since much of the Third Dynasty's business was conducted in Disty territory, its disappearance service, Privacy Unlimited, had to be one of the best in the galaxy.

Something in my face must have given my knowledge away, because she said, "Now do you understand my problem?"

"Frankly, no," I said. "You're the daughter of the big kahuna. Go to Privacy Unlimited and have them help you. It's usually not too hard to retrace steps."

She shook her head. "My mother didn't go to Privacy Unlimited. She used another service."

"You're sure?"

"Yes." She brushed a hand alongside her head, to move the long hair. "It's my father she's running from."

A domestic situation. I never get involved in those. Too messy and too complicated. Never a clear line. "Then she didn't need a service at all. She probably took a shuttle here, then a transport for parts unknown."

Anetka Sobol crossed her arms. "You don't seem to understand, Mr. Flint. My father could have found her with his own service if she had done something like that. It's simple enough. My detectives should have been able to find her. They can't."

"Let me see if I can understand this," I said. "Are you looking for her or is your father?"

"I am."

"As a front for him?"

Color flooded her face. "No."

"Then why?"

"I want to meet her."

I snorted. "You're going to a lot of expense for a 'hello, how are you.' Aren't you afraid Daddy will find out?"

"I have my own money."

"Really? Money Daddy doesn't know about? Money Daddy doesn't monitor?"

She straightened. "He doesn't monitor me."

I nodded. "That's why the mesh gloves. Fashion statement?"

She glanced at her enhancements. "I got them. They have nothing to do with my father."

My smile was small. "Your father has incredible resources. You don't think he'd do something as simple as hack into your enhancement files. Believe me, one of those pretty baubles is being used to track you, and if my security weren't as good as it is, another would have been monitoring this conversation."

She put her left hand over her right as if covering the enhancements would make me forget them. All it did was remind me that this time, she didn't react when my security shut down her links. This was one smart girl, and one I didn't entirely understand.

"Go home," I said. "Deal with Daddy. If you want family ties, get married, have

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children, hire someone to play your mother. If you need genetic information or disease history, see your family doctors. I suspect they'll have all the records you need and probably some you don't. If you want Daddy to leave you alone, I'd ask him first before I go to any more expense. He might just do what you want. And if you're trying to make him angry, I'll bet you've gone far enough. You'll probably be hearing from him very soon."

Her eyes narrowed. "You're so sure of yourself, Mr. Flint."

"It's about the only thing I am sure of," I said, and waited for her to leave.

She didn't. She stared at me for a long moment, and in her eyes, I saw a coldness, a hardness I hadn't expected. It was as if she were evaluating me and finding me lacking.

I let her stare. I didn't care what she thought one way or another. I did wish she would get to the point so that I could kick her out of my office.

Finally she sighed and pursed her lips as if she had eaten something sour. She looked around, probably searching for some place to sit down. She didn't find one. I don't like my clients to sit. I don't want them to be comfortable in my presence.

"All right," she said, and her voice was somehow different. Stronger, a little more powerful. I knew the timidity had been an act. "I came to you because you seem to be the only one who can do this job."

My smile was crooked and insincere. "Flattery."

"Truth," she said.

I shook my head. "There are dozens of people who do this job, and most are cheaper." I let my smile grow colder. "They also have chairs in their offices."

"They value their clients," she said.

"Probably at the expense of the people they're searching out."

"Ethics," she said. "That's why I've come here. You're the only one in your profession who seems to have any."

"You have need of ethics?" Somehow I had trouble believing the woman with that powerful voice had need of anyone with ethics. "Or is this simply another attempt at manipulation?"

To my surprise, she smiled. The expression was stunning. It brought life to her eyes, and somehow seemed to make her even taller than she had been a moment before.

"Manipulation got me to you," she said. "Your Mr. Gonnot seems to have a soft spot for people who are missing family."

"Everyone who's missing is a member of a family," I said, but more to the absent Gonnot than to her. I could see how he could be manipulated, and that made it more important than ever to stop him from sending customers my way.

She shrugged at my comment, then she sat on the edge of my desk. I'd never had anyone do that, not in all my years in the business. "I do have need of ethics," she said. "If you breathe a single word of what I'm going to tell you..."

She didn't finish the sentence, on purpose of course, probably figuring that whatever I could imagine would be worse than what she could come up with.

I sighed. This girl—this woman—liked games.

"If you want the sanctity of a confessional," I said, "see a priest. If you want a profession that requires its practitioners to practice confidentiality as a matter of course, see a psychiatrist. I'll keep confidential whatever I deem worthy of confidentiality."

She folded her slender hands on her lap. "You enjoy judging your clients, don't you?"

I stared at her—up at her—which actually put me at a disadvantage. She was good at intimidation skills, even better than she had been as an actress. It made me uncomfortable, but somehow it seemed more logical for the daughter of the man who ran the Third Dynasty.

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"I have to," I said. "A lot of lives depend on my judgments."

She shook her head slightly. It was as if my earlier answer stymied her, prevented her from continuing. She had to learn that we would do this on my terms or we wouldn't do it at all.

I waited. I could wait all day if I had to. Most people didn't have that kind of patience no matter what sort of will they had.

She clearly didn't. After a few moments, she brushed her pants, adjusted the flap on one of the pockets, and sighed again. She must have needed me badly.

Finally, she closed her eyes, as if summoning strength. When she opened them, she was looking at me directly. "I am a clone, Mr. Flint."

Whatever I had thought she was going to say, it wasn't that. I worked very hard at keeping the surprise off my face.

"And my father is dying." She paused, as if she were testing me.

I knew the answer, and the problem. When her father died, she couldn't inherit. Clones were barred from familial inheritance by interstellar law. The law had been adapted universally after several cases where clones created by a nonfamily member and raised far from the original (wealthy) family inherited vast estates. The basis of the inheritance was a shared biology that anyone could create. Rather than letting large fortunes get leached off to whoever was smart enough to steal a hair from a hairbrush and use it to create a copy of a human being, legislators finally decided to create the law. The courts upheld it. It was rigid.

"Your father could change his will," I said, knowing that she had probably broached this with him already.

"It's too late," she said. "He's been ill for a while. The change could easily be disputed in court."

"So you're not an only child?" I had to work to keep from asking if she were an only copy.

"I am the only clone," she said. "My father had me made, and he raised me himself. I am, for all intents and purposes, his daughter."

"Then he should have changed his will long ago."

She waved a hand, as if the very idea were a silly one. And it probably was. A clone had to come from somewhere. So either she was the copy of a real child or a copy of the woman she wanted me to find. Perhaps the will was unchanged because the original person was still out there.

"My mother vanished with the real heir," she said.

I waited.

"My father always expected to find them. My sister is the one who inherits."

I hated clone terminology. "Sister" was such an inaccurate term, even though clones saw themselves as twins. They weren't. They weren't raised that way or thought of that way. The Original stood to inherit. The clone before me did not.

"So you, out of the goodness of your heart, are searching for your missing family." I laid the sarcasm on thick. I've handled similar cases before. Where money was involved, people were rarely altruistic.

"No," she said, and her bluntness surprised me. "My father owns 51 percent of the Third Dynasty. When he dies, it goes into the corporation itself, and can be bought by other shareholders. I am not a shareholder, but I have been raised from birth to run the Dynasty. The idea was that I would share my knowledge with my sister, and that we would run the business together."

This made more sense.

"So I need to find her, Mr. Flint, before the shares go back into the corporation. I need to find her so that I can live the kind of life I was raised to live."

I hated cases like this. She was right. I did judge my clients. And if I found them the least bit suspicious, I didn't take on the case. If I believed that what they would do would jeopardize the Dis-

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appeared, I wouldn't take the case either. But if the reason for the disappearance was gone, or if the reason for finding the missing person benefited or did not harm the Disappeared, then I would take the case.

I saw benefit here, in the inheritance, and in the fact that the reason for the disappearance was dying.

"Your father willed his entire fortune to his missing child?"

She nodded.

"Then why isn't he searching for her?"

"He figured she would come back when she heard of his death."

Possible, depending on where she had disappeared to, but not entirely probable. The girl might not even know who she was.

"If I find your mother," I said, "then will your father try to harm her?"

"No," she said. "He couldn't if he wanted to. He's too sick. I can forward the medical records to you."

One more thing to check. And check I would. I guess I was taking this case, no matter how messily she started it. I was intrigued, just enough.

"Your father doesn't have to be healthy enough to act on his own," I said. "With his money, he could hire someone."

"I suppose," she said. "But I control almost all of his business dealings right now. The request would have to go through me."

I still didn't like it, but superficially, it sounded fine. I would, of course, check it out. "Where's your clone mark?"

She frowned at me. It was a rude question, but one I needed the answer to before I started.

She pulled her hair back, revealing a small number eight at the spot where her skull met her neck. The fine hairs had grown away from it, and the damage to the skin had been done at the cellular level. If she tried to have the eight removed, it would grow back.

"What happened to the other seven?" I asked.

She let her hair fall. "Failed."

Failed clones were unusual. Anything unusual in a case like this was suspect.

"My mother," she said, as if she could hear my thoughts, "was pregnant when she disappeared. I was cloned from sloughed cells found in the amnio."

"Hers or the baby's?"

"The baby's. They tested. But they used a lot of cells to find one that worked. It took a while before they got me."

Sounded plausible, but I was no expert. More information to check.

"Your father must have wanted you badly."

She nodded.

"Seems strange that he didn't alter his will for you."

Her shoulders slumped. "He was afraid any changes he made wouldn't have been lawyer-proof. He was convinced I'd lose everything because of lawsuits if he did that."

"So he arranged for you to lose everything on his own."

She shook her head. "He wanted the family together. He wanted me to work with my sister to—"

"So he said."

"So he says." She ran a hand through her hair. "I think he hopes that my sister will cede the company to me. For a percentage, of course."

There it was. The only loophole in the law. A clone could receive an inheritance if it came directly from the person whose genetic material the clone shared, provided that the Original didn't die under suspicious circumstances. Of course, a living person could, in Anetka's words, "cede" that ownership as well, although it was a bit more difficult.

"You're looking for her for money," I said in my last-ditch effort to get out of the case.

"You won't believe love," she said.

She was right. I wouldn't have.

"Besides," she said. "I have my own money. More than enough to keep me comfortable for the rest of my life.

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Whatever else you may think of my father, he has provided that. I'm searching for her for the corporation. I want to keep it in the family. I want to work it like I was trained. And this seems to be the only way."

It wasn't a very pretty reason, and I'd learned over the years, it was usually the ugly reasons that were the truth. Not, of course, that I could go by gut. I wouldn't.

"My retainer is two million credits," I said. "If you're lucky, that's all this investigation will cost you. I have a contract that I'll send to you or your personal representative, but let me give you the short version verbally."

She nodded.

I continued, reciting, as I always did, the essential terms so that no client could ever say I'd lied to her. "I have the right to terminate at any time for any reason. You may not terminate until the Disappeared is found, or I have concluded that the Disappeared is gone for good. You are legally liable for any lawsuits that arise from any crimes committed by third parties as a result of this investigation. I am not. You will pay me my rate plus expenses whenever I bill you. If your money stops, the investigation stops, but if I find you've been withholding funds to prevent me from digging farther, I am entitled to a minimum of ten million credits. I will begin my investigation by investigating you. Should I decide you are unworthy as a client before I begin searching for the Disappeared, I will refund half of your initial retainer. There's more but those are the salient points. Is all of that clear?"

"Perfectly."

"I'll begin as soon as I get the retainer."

"Give me your numbers and I'll have the money placed in your account immediately."

I handed her my single printed card with my escrow account embedded into it. The account was a front for several other accounts, but she didn't need to know that. Even my money went through channels. Someone who is good at finding the Disappeared is also good at making other things disappear.

"Should you need to reach me in an emergency," I said, "place 673 credits into this account."

"Strange number," she said.

I nodded. The number varied from client to client, a random pattern. Sometimes, past clients sent me their old amounts as a way to contact me about something new. I kept the system clear.

"I'll respond to the depositing computer from wherever I am, as soon as I can. This is not something you should do frivolously nor is it something to be done to check up on me. It's only for an emergency. If you want to track the progress of the investigation, you can wait for my weekly updates."

"And if I have questions?"

"Save them for later."

"What if I think I can help?"

"Leave me mail." I stood. She was watching me, that hard edge in her eyes again. "I've got work to do now. I'll contact you when I'm ready to begin my search."

"How long will this investigation of me take?"

"I have no idea," I said. "It depends on how much you're hiding."

IV

Clients never tell the truth. No matter how much I instruct them to, they never do. It seems to be human nature to lie about something, even when it's something small. I had a hunch, given Anetka Sobol's background, she had lied about a lot. The catch was to find out how much of what she had lied about was relevant to the job she had hired me for. Finding out required research.

I do a lot of my research through public accounts, using fake ID. It is precautionary, particularly in the beginning, because so many cases don't pan out. If a Disappeared still has a Tracker after her, repeated searches from me will be flagged. Searches from public accounts—especially different public ac-

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counts—will not. Often the Disappeared are already famous or become famous when they vanish, and are often the subject of anything from vidspec to school reports.

My favorite search site is a bar not too far from my office. I love the place because it serves some of the best food in Armstrong, in some of the largest quantities. The large quantities are required, given the place's name. The Brownie Bar serves the only marijuana in the area, baked into specially marked goods, particularly the aforementioned brownies. Imbibers get the munchies, and proceed to spend hundreds of credits on food. The place turns quite a profit, and it's also comfortable; marijuana users seem to like their creature comforts more than most other recreational drug types.

Recreational drugs are legal on the Moon, as are most things. The first settlers came in search of something they called "freedom from oppression" which usually meant freedom to pursue an alternative lifestyle. Some of those lifestyles have since become illegal or simply died out, but others remain. The only illegal drugs these days, at least in Armstrong, are those that interfere with the free flow of air. Everything from nicotine to opium is legal—as long as its user doesn't smoke it.

The Brownie Bar caters to the casual user as well as the hard-core and, unlike some drug bars, doesn't mind the nonuser customer. The interior is large with several sections. One section, the party wing, favors the bigger groups, the ones who usually arrive in numbers larger than ten, spend hours eating and giggling, and often get quite obnoxiously wacky. In the main section, soft booths with tables shield clients from each other. Usually the people sitting there are couples or groups of four. If one group gets particularly loud, a curtain drops over the open section of the booth, and their riotous laughter fades to nearly nothing.

My section caters to the hard core, who sometimes stop for a quick fix in the middle of the business day, or who like a brownie before dinner to calm the stress of a hectic afternoon. Many of these people have only one, and continue work while they're sitting at their solitary tables. It's quiet as a church in this section, and many of the patrons are plugged into the client ports that allow them access to the Net.

The access ports are free, but the information is not. Particular servers charge by the hour in the public areas, but have the benefit of allowing me to troll using the server or the bar's identicodes. I like that; it usually makes my preliminary searches impossible to trace.

That afternoon, I took my usual table in the very back. It's small, made of high-grade plastic designed to look like wood—and it fools most people. It never fooled me, partly because I knew the Brownie Bar couldn't afford to import, and partly because I knew they'd never risk something that valuable on a restaurant designed for stoners. I sat cross-legged on the thick pillow on the floor, ordered some turkey stew—made here with real meat—and plugged in.

The screen was tabletop and had a keyboard so that the user could have complete privacy. I'd heard other patrons complain that using the Brownie Bar's system required them to read, but it was one of the features I liked.

I started with Anetka and decided to work my way backwards through the Sobol family. I found her quickly enough; her life was well covered by the tabs, which made no mention of her clone status. She was twenty-seven, ten to twelve years older than she looked. She'd apparently had those youthful looks placed in stasis surgically. She'd look girlish until she died.

Another good fact to know. If there was an Original, she might not look like Anetka. Not any more.

Anetka had been working in her fa-

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ther's corporation since she was twelve. Her IQ was off the charts—surgically enhanced as well, at least according to most of the vidspec programs—and she breezed through Harvard and then Cambridge. She did postdoc work at the Interstellar Business School in Islamabad, and was out of school by the time she was twenty-five. For the last two years, she'd been on the corporate fast track, starting in lower management and working her way to the top of the corporate ladder.

She was, according to the latest feeds, her father's main assistant.

So I had already found Possible Lie Number One: She wasn't here for herself. She was, as I had suspected, a front for her father. Not to find the wife, but to find the real heir.

I wasn't sure how I'd feel if that were true. I needed to find out if, indeed, the Original was the one who'd inherit. If she wasn't, I wouldn't take the case. There'd be no point.

But I wasn't ready to make judgements yet. I had a long way to go. I looked up Anetka's father and discovered that Carson Sobol had never remarried, although he'd been seen with a bevy of beautiful women over the years. All were close to his age. He never dated women younger than he was. Most had their own fortunes, and many their own companies. He spent several years as the companion to an acclaimed Broadway actress, even funding some of her more famous plays. That relationship, like the others, had ended amicably.

Which led to Possible Lie Number Two: a man who terrorized his wife so badly that she had to run away from him also terrorized his later girlfriends. And while a man could keep something like that quiet for a few years, eventually the pattern would become evident. Eventually one of the women would talk.

There was no evidence of terrorizing in the stuff I found. Perhaps the incidents weren't reported. Or perhaps there was nothing to report. I would vote for the latter. It seemed, from the vidspec I'd read, everyone knew that the wife had left him because of his cruelty. My experience with vidspec reporters made me confident that they'd be on the lookout for more proof of Carson Sobol's nasty character. And if they found it, they'd report it.

No one had.

I didn't know if that meant Sobol had learned his lesson when the wife ran off, or perhaps Sobol had learned that mistreatment of women was bad for business. I couldn't believe that a man could terrify everyone into silence. If that were his methodology, there would be a few leaks that were quickly hushed up, and one or two dead bodies floating around—bodies belonging to folks who hadn't listened. Also, there would be rumors, and there were none.

Granted, I was making assumptions on a very small amount of information. Most of the reports I found about Sobol weren't about his family or his love life, but about the Third Dynasty as it expanded in that period to new worlds, places that human businesses had never been before.

The Third Dynasty had been the first to do business with the Fuetrer, the HDs, and the chichers. It opened plants on Korsve, then closed them when it realized that the Wygnin, the dominant life-form on Korsve, did not—and apparently could not—understand the way that humans did business.

I shuddered at the mention of Korsve. If a client approached me because a family member had been taken by the Wygnin, I refused the case. The Wygnin took individuals to pay off debt, and then those individuals became part of a particular Wygnin family. For particularly heinous crimes, the Wygnin took firstborns, but usually, the Wygnin just took babies—from any place in the family structure—at the time of birth, and then raised them. Occasionally they'd take an older child or an adult. Sometimes they'd take an entire group of adults

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from offending businesses. The adults were subject to mind control and personality destruction as the Wygnin tried to remake them to fit into Wygnin life.

All of that left me with no good options. Children raised by the Wygnin considered themselves Wygnin and couldn't adapt to human cultures. Adults who were taken by the Wygnin were so broken that they were almost unrecognizable. Humans raised by the Wygnin did not want to return. Adults who were broken always wanted to return, and when they did, they signed a death warrant for their entire family—or worse, doomed an entire new generation to kidnap by the Wygnin.

But Wygnin custom didn't seem relevant here. Despite the plant closings, the Third Dynasty had managed to avoid paying a traditional Wygnin price. Or perhaps someone had paid down the line, and that information was classified.

There were other possibles in the files. The Third Dynasty seemed to have touched every difficult alien race in the galaxy. The corporation had an entire division set aside for dealing with new cultures. Not that the division was infallible. Sometimes there were unavoidable errors.

Sylvy Sobol's disappearance had been one of those. It had caused all sorts of problems for both Sobol and the Third Dynasty. The vidspecs, tabs, and other media had had a field day when she had disappeared. The news led to problems with some of the alien races, particularly the Altaden. The Altaden valued non-violence above all else, and the accusations of domestic violence at the top levels of the Third Dynasty nearly cost the corporation its Altade holdings.

The thing was, no one expected the disappearance—or the marriage, for that matter. Sylvy Sobol had been a European socialite, better known for her charitable works and her incredible beauty than her interest in business. She belonged to an old family with ties to several still-existing monarchies. It was thought that her marriage would be to someone else from the accepted circle.

It had caused quite a scandal when she had chosen Carson Sobol, not only because of his mixed background and uncertain lineage, but also because some of his business practices had taken large fortunes from the countries she was tied to and spent them in space instead.

He was controversial; the marriage was controversial; and it looked, from the vids I watched, like the two of them had been deeply in love.

I felt a hand on my shoulder. A waitress stood behind me, holding a large ceramic bowl filled with turkey stew. She smiled at me.

"Didn't want to set it on your work."

"It's fine," I said, indicating an empty spot near the screen. She set my utensils down, and then the bowl. The stew smelled rich and fine, black beans and yogurt adding to the aroma. My stomach growled.

The waitress tapped one of the moving images. "I remember that," she said. "I was living in Vienna. The Viennese thought that marriage was an abomination."

I looked up. She was older than I was, without the funds to prevent the natural aging process. Laugh lines crinkled around her eyes, and her lips—unpainted and untouched—were a faint rose. She smiled.

"Guess it turned out that way, huh? The wife running off like that? Leaving that message?"

"Message?" I asked. I hadn't gotten that far.

"I don't remember exactly what it was. Something like 'The long arm of the Third Dynasty is impossible to fight. I am going where you can't find me. Maybe then I'll have the chance to live out my entire life.' I guess he nearly beat her to death." The waitress laughed, a little embarrassed. "In those days I had nothing better to do than study the lives of more interesting people."

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"And now?" I asked.

She shrugged. "I figured out that everybody's interesting. I mean, you've got to try. You've got to live. And if you do, you've done something fascinating."

I nodded. People like her were one of the reasons I liked this place.

"You want something to drink?" she asked.

"Bottled water."

"Got it," she said as she left.

By the time she brought my bottled water, I had indeed found the note. It had been sent to all the broadcast media, along with a grainy video, taken from a hidden camera, of one of the most brutal domestic beatings I'd ever seen. The images were sometimes blurred and indistinct, but the actions were clear. The man had beat the woman senseless.

There was no mention of the pregnancy in any of this. There was, however, notification of Anetka's birth six months before her mother had disappeared.

Which led me to Possible Lie Number Three. Anetka had said her mother traveled pregnant. Perhaps she hadn't. Or, more chillingly, someone had altered the record either before or after the clones were brought to term. There had to be an explanation of Anetka in the media or she wouldn't be accepted. If that explanation had been planted before, something else was going on. If it were planted afterwards, Sobol's spokespeople could have simply said that reporters had overlooked her in their rush to other stories.

I checked the other media reports and found the same story. It was time to go beneath those stories and see what else I could find. Then I would confront Anetka about the lies before I began the search for her mother.

V

I contacted her and we met, not at my office, but at her hotel. She was staying in Armstrong's newest district, an addition onto the dome that caused a terrible controversy before it was built. Folks in my section believe the reason for the thinner air is that the new addition has stretched resources. I know they aren't right—with the addition came more air and all the other regulation equipment—but it was one of those arguments that made an emotional kind of sense.

I thought of those arguments, though, as I walked among the new buildings, made from a beige material not even conceived of thirty years before, a material that's supposed to be attractive (it isn't) and more resistant to decay than permaplastic. This entire section of Armstrong smelt new, from the recycled air to the buildings rising around me. They were four stories high and had large windows on the dome side, obviously built with a view in mind.

This part of the dome is self-cleaning and see-through. Dust does not slowly creep up the sides as it does in the other parts of Armstrong. The view is barren and stark, just like the rest of the Moon, but there's a beauty in the starkness that I don't see anywhere else in the universe.

The hotel was another large four-story building. Most of its windows were glazed dark, so no one could see in, but the patrons could see out. It was part of a chain whose parent company was, I had learned the day before, the Third Dynasty. Anetka was doing very little to hide her search from her father.

Inside, the lobby was wide, and had an old-fashioned feel. The walls changed images slowly, showing the famous sites from various parts of the galaxy where the hotels were located. I had read before the hotel opened that the constantly changing scenery took eight weeks to repeat an image. I wondered what it was like working in a place where the view shifted constantly, and then decided I didn't want to know.

The lobby furniture was soft and a comforting shade of dove gray. Piano

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music, equally soft and equally comforting, was piped in from somewhere. Patrons sat in small groups as if they were posing for a brochure. I went up to the main desk and asked for Anetka. The concierge led me to a private conference room down the main hallway.

I expected the room to be monitored. That didn't bother me. At this point, I still had nothing to hide. Anetka did, but this was her company's hotel. She could get the records, shut off the monitors, or have them destroyed. It would all be her choice.

To my surprise, she was waiting for me. She was wearing another dress, a blue diaphanous thing that looked so fragile I wondered how she managed to move from place to place. Her hair was up and pinned, with diamonds glinting from the soft folds. She also had diamonds glued to the ridge beneath her eyebrows, and trailing down her cheeks. The net effect was to accent her strength. Her broad shoulders held the gown as if it were air, and the folds parted to reveal the muscles on her arms and legs. She was like the diamonds she wore; pretty and glittering, but able to cut through all the objects in the room.

"Have you found anything?" she asked without preamble.

I shut the door and helped myself to the carafe of water on the bar against the nearest wall. There was a table in the center of the room—made, it seemed—of real wood, with matching chairs on the side. There was also a workstation, and a one-way mirror with a view of the lobby.

I leaned against the bar, holding my water glass. It was thick and heavy, sturdy like most things on the Moon. "Your father's will has been posted among the Legal Notices on all the nets for the last three years."

She nodded. "It's common for CEOs to do that to allay stockholder fears."

"It's common for CEOs to authorize the release after they've died. Not before."

Her smile was small, almost patronizing. "Smaller corporations, yes. But it's becoming a requirement for major shareholders in megacorps to do this even if they are not dead. Investigate farther, Mr. Flint, and you'll see that all of the Third Dynasty's major shareholders have posted their wills."

I had already checked the other shareholders' wills, and found that Anetka was right. I also looked for evidence that Carson Sobol was dead, and found none.

She took my silence to be disbelief. "It's the same with the other megacorps. Personal dealings are no longer private in the galactic business world."

I had known that the changes were taking place. I had known, for example, that middle managers signed loyalty oaths to corporations, sometimes requiring them to forsake family if the corporation called for it. This, one pundit had said, was the hidden cost of doing business with alien races. You had to be willing to abandon all you knew in the event of a serious mistake. The upshot of the change was becoming obvious. People to whom family was important were staying away from positions of power in the megacorps.

I said, "You're not going to great lengths to hide this search from your father."

She placed a hand on the wooden chair. She was not wearing gloves, and mingled among the enhancements were more diamonds. "You seem obsessed with my father."

"Your mother disappeared because of him. I'm not going to find her only to have him kill her."

"He wouldn't."

"Says you."

"This is your hesitation?"

"Actually, no," I said. "My hesitation is that, according to all public records, you were born six months before your mother disappeared."

I didn't tell her that I knew all the databases had been tampered with, in-

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cluding the ones about her mother's disappearance. I couldn't tell if the information had been altered to show that the disappearance came later or that the child had been born earlier. The tampering was so old that the original material was lost forever.

"My father wanted me to look like a legitimate child."

"You are a clone. He knew cloning laws."

"But no one else had to know."

"Not even with his will posted?"

"Like you said, it's only been posted for the last three years."

"Is that why you're not mentioned?"

She raised her chin. "I received my inheritance before—already," she said. I found the correction interesting. "The agreement between us about my sister is both confidential and binding."

"'All of my worldly possessions shall go to my eldest child,'" I quoted. "That child isn't even listed by name."

"No," she said.

"And he isn't going to change the will for you?"

"The Disty won't do business with clones."

"I didn't know you had business with the Disty," I said.

She shrugged. "The Disty, the Emin, the Revs. You name them, we have business with them. And we have to be careful of some customs."

"Won't the stockholders be suspicious when you don't inherit?"

Her mouth formed a thin line. "That's why I'm hiring you," she said. "You need to find my sister."

I nodded. Then, for the first time in the meeting, I sat down. The chair was softer than I had expected it would be. I put my feet on the nearest chair. She glanced at them as if they were a lower life-form.

"In order to search for people," I said, "I need to know who they're running from. If they're running from the Disty, for example, I'll avoid the Martian colonies, because they're overrun with Disty. No one would hide there. It would be impossible. If they were running from the Revs, I would start looking at plastic surgeons and doctors who specialize in genetic alteration because anyone who looks significantly different from the person the Revs have targeted is considered, by the Revs, to be a different being entirely."

She started to say something, but I held up my hand to silence her.

"Human spouses abuse each other," I said. "It seems to be part of the human experience. These days, the abused spouse moves out, and sometimes leaves the city, sometimes the planet, but more often than not stays in the same area. It's unusual to run, to go through a complete identity change, and to start a new life, especially in your parents' income bracket. So tell me, why did your mother really leave?"

Nothing changed in Anetka's expression. It remained so immobile that I knew she was struggling for control. The hardness that had been so prevalent the day before was gone, banished, it seemed, so that I wouldn't see anything amiss.

"My father has a lot of money," she said.

"So do other people. Their spouses don't disappear."

"He also controls a powerful megacorp with fingers all over the developing worlds. He has access to more information than anyone. He vowed to never let my mother out of his sight. My father believed that marriage vows were sacred, and no matter how much the parties wanted out, they were obligated by their promises to each other and to God to remain." Anetka's tone was flat too. "If she had just moved out, he would have forced her to move back in. If she had moved to the Moon, he would have come after her. If she had moved to some of the planets in the next solar system, he would have come for her. So she had no choice."

"According to your father."

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"According to anyone who knew her." Anetka's voice was soft. "You saw the vids."

I nodded.

"That was mild, I guess, for what he did to her."

I leaned back in the chair, lifting the front two legs off the ground. "So how come he didn't treat his other women that way?"

Something passed through her eyes so quickly that I wasn't able to see what the expression was. Suspicion? Fear? I couldn't tell.

"My father never allowed himself to get close to anyone else."

"Not even his Broadway actress?"

She frowned, then said, "Oh, Linda? No. Not even her. They were using each other to throw off the media. She had a more significant relationship with one of the major critics, and she didn't want that to get out."

"What about you?" I asked that last softly. "If he hurt your mother, why didn't he hurt you?"

She put her other hand on the chair as if she were steadying herself. "Who says he didn't?"

And in that flatness of tone, I heard all the complaints I'd ever heard from clones. She had legal protection, of course. She was fully human. But she didn't have familial protection. She wasn't part of any real group. She didn't have defenders, except those she hired herself.

But I didn't believe it, not entirely. She was still lying to me. She was still keeping me slightly off balance. Something was missing, but I couldn't find it. I'd done all the digging I could reasonably do. I had no direction to go except after the missing wife—if I chose to continue working on this case. This was the last point at which I could comfortably extricate myself from the entire mess.

"You're not telling me everything," I said.

Again, the movement with the eyes. So subtle. So quick. I wondered if she had learned to cover up her emotions from her father.

"My father won't harm her," she said. "If you want, I'll even sign a waiver guaranteeing that."

It seemed the perfect solution to a superficial problem. I had a hunch there were other problems lurking below.

"I'll have one sent to you," I said.

"Are you still taking the case?"

"Are you still lying to me?"

She paused, the dress billowing around her in the static-charged air. "I need you to find my sister," she said.

And that much, we both knew to be true.

VI

My work is nine-tenths research and one-tenth excitement. Most of the research comes in the beginning, and it's dry to most people, although I still find the research fascinating. It's also idiosyncratic and part of the secret behind my reputation. I usually don't describe how I do the research—and I never explain it to clients. I usually summarize it, like this:

It took me four months to do the preliminary research on Sylvy Sobol. I started from the premise that she was pregnant with a single girl child. A pregnant woman did one of three things: she carried the baby to term, she miscarried, or she aborted. After dealing with hospital records for what seemed like weeks, I determined that she carried the baby to term. Or at least, she hadn't gotten rid of it before she disappeared.

A pregnant woman had fewer relocation options than a non-pregnant one. She couldn't travel as far or on as many forms of transport because it might harm the fetus. Several planets, hospitable to humans after they'd acclimatized, were not places someone in the middle of pregnancy was allowed to go. The pregnancy actually made my job easier, and I was glad for it.

Whoever had hidden her was good, but no disappearance service was per-

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fect. They all had cracks in their systems, some revealing themselves in certain types of disappearance, others in all cases past a certain layer of complexity. I knew those flaws as well as I knew the scars and blemishes on my own hands. And I exploited them with ease.

At the end of four months, I had five leads on the former Mrs. Sobol. At the end of five months, I had eliminated two of those leads. At the end of six months, I had a pretty good idea which of the remaining three leads was the woman I was looking for.

I got in my ship, and headed for Mars.

VII

In the hundred years since the Disty first entered this solar system, they have taken over Mars. The human-run mineral operations and the ship bases are still there, but the colonies are all Disty-run, and some are Disty-built.

The Emmeline has clearance on most planets where humans make their homes. Mars is no different. I docked at the Dunes, above the Arctic Circle, and wished I were going elsewhere. It was the Martian winter, and here, in the largest field of sand dunes in the solar system, that meant several months of unrelenting dark.

I had never understood how the locals put up with this. But I hadn't understood a lot of things. The domes here, mostly of human construction, had an artificial lighting system built in, but the Disty hated the approximation of a twenty-four hour day. Since the Disty had taken over the northernmost colonies, darkness outside and artificial lights inside were the hallmarks of winter.

The Disty made other alterations as well. The Disty were small creatures with large heads, large eyes, and narrow bodies. They hated the feeling of wide open spaces, and so in many parts of the Sahara Dome, as Terrans called this place, false ceilings had been built in, and corridors had been compressed. Buildings were added into the wider spaces, getting rid of many passageways and making the entire place seem like a rat's warren. Most adult humans had to crouch to walk comfortably through the city streets and some, in disgust, had bought small carts so that they could ride. The result was a congestion that I found claustrophobic at the best of times. I hated crouching when I walked, and I hated the stink of so many beings in such a confined space.

Many Terran buildings rose higher than the ceiling level of the street, but to discourage that wide-open-spaces feel, the Disty built more structures, many of them so close together that there was barely enough room for a human to stick his arm between them. Doors lined the crowded streets, and the only identifying marks on most places were carved into the frame along the door's side. The carvings were difficult to see in the weird lighting, even if there weren't the usual crowds struggling to get through the streets to God knew where.

My candidate lived in a building owned by the Disty. It took me two passes to find the building's number, and another to realize that I had found the right place. A small sign, in English, advertised accommodations fit for humans, and my back and I hoped that the sign was right.

It was. The entire building had been designed with humans in mind. The Disty had proven themselves to be able interstellar traders, and quite willing to adapt to local customs when it suited them. It showed in the interior design of this place. Once I stepped through the door, I was able to stand upright, although the top of my head did brush the ceiling. To my left, a sign pointed toward the main office, another pointed to some cramped stairs, and a third pointed to the recreation area.

I glanced at the main office before I explored any farther. The office was up front, and had the same human-sized ceilings. In order to cope, the Disty run-

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ning the place sat on its desk, its long feet pressed together in concentration. I passed it, and went to the recreation area. I would look for the woman here before I went door to door upstairs.

The recreation area was about half the size of an human-made room for the same purpose. Still, the Disty managed to cram a lot of stuff in here, and the closeness of everything—while comfortable for the Disty—made it uncomfortable for any human. All five humans in the room were huddled near the bar on the far end. It was the only place with a walking path large enough to allow a full-grown man through.

To get there, I had to go past the Ping-Pong table, and a small section set aside for Go players. Several Disty were playing Go—they felt it was the best thing they had discovered on the planet Earth, with Ping-Pong a close second—sitting on the tables so that their heads were as near the ceiling as they could get. Two more Disty were standing on the table, playing Ping-Pong. None of them paid me any attention at all.

I wound my way through the tight space between the Go players and the Ping-Pong table, ducking once to avoid being whapped in the head with an out-of-control Ping-Pong ball. I noted three other Disty watching the games with rapt interest. The humans, on the other hand, had their backs to the rest of the room. They were sitting on the tilting bar stools, drinking, and not looking too happy about anything.

A woman who could have been anywhere from thirty to seventy-five sat at one end of the bar. Her black hair fell to the middle of her back, and she wore makeup, an affectation that the Disty seemed to like. She was slender—anyone who wanted to live comfortably here had to be—and she wore a silver beaded dress that accented that slimness. Her legs were smooth, and did not bear any marks from mining or other harsh work.

"Susan Wilcox?" I asked as I put my hand on her shoulder and showed her my license.

I felt the tension run through her body, followed by several shivers, but her face gave no sign that anything was wrong.

"Want to go talk?"

She smiled at me, a smooth professional smile that made me feel a little more comfortable. "Sure."

She stood, took my hand as if we'd been friends a long time, and led me onto a little patio someone had cobbled together in a tiny space behind the recreation area. I didn't see the point of the thing until I looked up. This was one of the few places in Sahara where the dome was visible, and through its clear surface, you could see the sky. She pulled over a chair, and I grabbed one as well.

"How did you find me?" she asked.

"I'm not sure I did." I held out my hand. In it was one of my palmtops. "I want to do a DNA check."

She raised her chin slightly. "That's not legal."

"I could get a court order."

She looked at me. A court order would ruin any protection she had, no matter who—or what—she was running from.

"I'm not going to see who you are. I want to see if you're who I'm looking for. I have comparison DNA."

"You're lying," she said softly.

"Maybe," I said. "If I am, you're in trouble either way."

She knew I was right. She could either take her chances with me, or face the court order where she had no chance at all.

She extended her hand. I ran the edge of the computer along her palm, removing skin cells. The comparison program ran, and as I turned the palmtop face-up, I saw that there was no match. The only thing this woman shared in common with the former Mrs. Sobol was that they were both females of a similar age, and that they had both disappeared

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twenty-nine years ago while pregnant. Almost everything else was different.

I used my wrist-top for a double-check, and then I sighed. She was watching me closely, her dark eyes reflecting the light from inside.

I smiled at her. "You're in the clear," I said. "But if it was this easy for me to find you, chances are that it'll be as easy for someone else. You might want to move on."

She shook her head once, as if the very idea were repugnant.

"Your child might appreciate it," I said.

She looked at me as if I had struck her. "She's not who—"

"No," I said. "She's safe. From me, at least. And maybe from whoever's after you. But you've survived out here nearly thirty years. You know the value of caution."

She swallowed, hard. "You know a lot about me."

"Not really." I stood. "I only know what you have in common with the woman I'm looking for." I slipped the palmtop into my pocket and bowed slightly. "I appreciate your time."

Then I went back inside, slipped through the recreation area, walked past two more Disty in the foyer, and headed into the narrow passageway they called a street. There I shuddered. I hated the Disty. I'd worked so many cases in which people ran to avoid being caught by the Disty that I'd become averse to them myself.

At least, that was my explanation for my shudder. But I knew that it wasn't a real explanation. I had put a woman's life in jeopardy, and we both knew it. I hoped no one had been paying attention. But I was probably wrong. The only solace I had was that since she was hiding amongst the Disty, she probably wasn't being sought by one of them. If she had been pursued by a Disty, my actions probably would have signed her death warrant.

I spent a night in a cramped hotel room since the Disty didn't allow take-offs within thirty-six hours of landing. And then I got the hell away from Sahara Dome—and Mars.

VIII

My second possible was in New Orleans, which made my task a lot easier. I had former clients there who felt they owed me, some of whom were in related businesses. I had one of those clients break into the Disappeared's apartment, remove a strand of hair, and give it to another former client. A third brought me the strand in my room in the International Space Station. Because the strand proved not to be a match, and because I was so certain it would be, I repeated the procedure once more, this time getting another old friend to remove another hair strand from the suspect's person. Apparently, he passed her in a public place, and plucked. The strand matched the first one, but didn't belong to Sylvy Sobol.

I didn't warn this woman at all because I didn't feel as if I had put her in danger. If she were suspicious about the hair-pulling incident, I felt it was her responsibility to leave town on her own.

The third candidate was on the Moon, in Hadley. I had no trouble finding her, which seemed odd, but she didn't check out either. I returned to Armstrong, both stumped and annoyed.

The logical conclusion was that my DNA sample was false—that it wasn't the sample for Sylvy Sobol. I had taken the sample from the Interstellar DNA database, and there was the possibility that the sample had been changed or tainted. I had heard of such a thing being done, but had always dismissed it as impossible. Those samples were the most heavily guarded in the universe. Even if someone managed to get into the system, they would encounter back-ups upon back-ups, and more encryption than I wanted to think about.

So I contacted Anetka and asked her to send me a DNA sample of her mother. She did, and I ran it against the sample I

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had. Mine had been accurate. The women I had seen were not Sylvy Sobol.

I had never, in my entire career, made an error of this magnitude. One of those women should have been the former Mrs. Sobol. Unless my information was wrong. Unless I was operating from incorrect assumptions. Still, the assumptions shouldn't have mattered in this search. A pregnant woman wasn't that difficult to hide, not when she was taking transport elsewhere. I'd even found the one who'd remained on Earth.

No. The incorrect assumption had to come after the pregnancy ended. The children. Transport registries always keep track of the sex of the fetus, partly as a response to a series of lawsuits where no one could prove that the woman who claimed she'd lost a fetus on board a transport had actually been pregnant. The transports do not do a DNA check—such things are considered violations of privacy in all but criminal matters—but they do require pregnant women to submit a doctor's report on the health of the mother and the fetus before the woman is allowed to board.

I'd searched out pregnant women, but only those carrying a single daughter. Not twins or multiples. And no males.

Anetka had mentioned failed clones. Clones failed for a variety of reasons, but they only failed in large numbers when someone was using a defective gene or was trying to make a significant change on the genetic level. If the changes didn't work at the genetic level, surgery was performed later to achieve the same result and the DNA remained the same.

I had Anetka's DNA. I'd taken it that first day without her knowing it. I ran client DNA only when I felt I had no other choice; sometimes to check identity, sometimes to check for past crimes. I hadn't run Anetka's—photographic, vid, and those enhancements made it obvious that she was who she said she was. I knew she wasn't concealing her identity, and there was no way she was fronting for a Disty or any other race. She had told me she was a clone. So I felt a DNA check was not only redundant, it was also unnecessary because it didn't give me the kind of information I was searching for.

But now things were different. I needed to check it to see if she was a repaired child, if there had been some flaw in the fetus that couldn't have been altered in the womb. I hadn't looked for repaired children when I'd done the hospital records scans. I hadn't looked for anything that complicated at all.

So I ran the DNA scan. It only took a second, and the results were not what I expected.

Anetka Sobol wasn't a repaired child, at least not in the sense that I had been looking for. Anetka Sobol was an altered child.

According to her DNA, Anetka Sobol had once been male.

IX

If the trail hadn't been so easy to follow once I realized I was looking for a woman pregnant with a boy, I wouldn't have traced it. I would have gone immediately to Anetka and called her on it. But the trail was easy to follow, and any one of my competitors would have done so—perhaps earlier because they had different methods than I did. I knew at least three of them that ran DNA scans on clients as a matter of course.

If Anetka went to any of them after I refused to complete the work, they would find her mother. It would take them three days. It took me less, but that was because I was better.

X

Sylvy Sobol ran a small private university in the Gagarin Dome on the Moon. She went by the name Celia Walker, and she had transferred from a school out past the Disty homeworld where she had spent the first ten years of her exile. She had run the university for fifteen years.

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Gagarin had been established fifty years after Armstrong, and was run by a governing board, the only colony that had such a government. The board placed covenants on any person who owned or rented property within the interior of the dome. The covenants covered everything from the important, such as oxygen regulators, to the unimportant, such as a maintenance schedule for each building, whether the place needed work or not. Gagarin did not tolerate any rules violations. If someone committed three such violations—whether they be failing to follow the maintenance schedule or murder—that person was banned from the dome for life.

The end result was that residents of Gagarin were quiet, law-abiding, and suspicious. They watched me as if I were a particularly distasteful bug when I got off the high speed train from Armstrong. I learned later that I didn't meet the dome's strict dress code.

I had changed into something more appropriate after I got my hotel room, and then went to campus. The university was a technical school for undergraduates, most of them local, but a few came in from other parts of the Moon. The administrative offices were in a low building with fake adobe facades. The classrooms were in some of Gagarin's only high rises, and were off limits to visitors.

I didn't care about that. I went straight to the Chancellor's office and buzzed myself in, even though I didn't have an appointment. Apparently, the open campus policy that the on-line brochures proudly proclaimed extended to the administrative offices as well.

Sylvy Sobol sat behind a desk made of Moon clay. Ancient southwestern tapestries covered the walls, and matching rugs covered the floor. The permaplastic here had been covered with more fake adobe, and the net effect was to make this seem like the American Southwest hundreds of years before.

She looked no different than the age-enhancement programs on my computer led me to believe she'd look. Her dark hair was laced with silver, her eyes had laugh lines in the corners, and she was as slender as she had been when she disappeared. She wore a blouse made of the same weave as the tapestries, and a pair of tan cargo pants. Beneath the right sleeve of her blouse a stylish wristtop glistened. When she saw me, she smiled. "May I help you?"

I closed the door, walked to her desk, and showed her my license. Her eyes widened ever so slightly, and then she covered the look.

"I came to warn you," I said.

"Warn me?" She straightened almost imperceptibly, but managed to look perplexed. Behind the tightness of her lips, I sensed fear.

"You and your son need to use a new service, and disappear again. It's not safe for you any more."

"I'm sorry, Mr.—Flint?—but I'm not following you."

"I can repeat what I said, or we can go somewhere where you'd feel more comfortable talking."

She shook her head once, then stood. "I'm not sure I know what we'd be talking about."

I reached out my hand. I had my palm scanner in it. Anyone who'd traveled a lot, anyone who had been on the run, would recognize it. "We can do this the old-fashioned way, Mrs. Sobol, or you can listen to me."

She sat down slowly. Her lower lip trembled. She didn't object to my use of her real name. "If you're what your identification says you are, you don't warn people. You take them in."

I let my hand drop. "I was hired by Anetka Sobol," I said. "She wanted me to find you. She claimed that she wanted to share her inheritance with her Original. She's a clone. The record supports this claim."

"So, you want to take us back." Her voice was calm, but her eyes weren't. I

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watched her hands. They remained on the desktop, flat, and she was without enhancement. So far, she hadn't signaled anyone for help.

"Normally, I would have taken you back. But when I discovered that Anetka's Original was male, I got confused."

Sylvy licked her lower lip, just like her cloned daughter did. An hereditary nervous trait.

I rested one leg on the corner of the desk. "Why would a man change the sex of a clone when the sex didn't matter? Especially if all he wanted was the child. A man with no violent tendencies, who stood accused of attacking his wife so savagely all she could do was leave him, all she could do was disappear. Why would he do that?"

She hadn't moved. She was watching me closely. Beads of perspiration had formed on her upper lip.

"So I went back through the records and found two curious things. You disappeared just after his business on Korsve failed. And once you moved to Gagarin, you and your son were often in other domed Moon colonies at the same time as your husband. Not a good way to hide from someone, now is it, Mrs. Sobol?"

She didn't respond.

I picked up a clay pot. It was small and very, very old. It was clearly an original, not a Moon-made copy. "And then there's the fact that your husband never bothered to change his will to favor the child he had raised. It wouldn't have mattered to most parents that the child was a clone, especially when the Original was long gone. He could have arranged a dispensation, and then made certain that the business remained in family hands." I set the pot down. "But he had already done that, hadn't he? He hoped that the Wygnin would forget."

She made a soft sound in the back of her throat, and backed away from me, clutching at her wrist. I reached across the desk and grabbed her left arm, keeping her hand away from her wrist-top. I wasn't ready for her to order someone to come in here. I still needed to talk to her alone.

"I'm not going to turn you in to the Wygnin," I said. "I'm not going to let anyone know where you are. But if you don't listen to me, someone else will find you, and soon."

She stared at me, the color high in her cheeks. Her arm was rigid beneath my hand.

"The will was your husband's only mistake," I said. "The Wygnin never forget. They targeted your firstborn, didn't they? The plants on Korsve didn't open and close without a fuss. Something else happened. The Wygnin only target firstborns for a crime that can't be undone."

She shook her arm free of me. She rubbed the spot where my hand had touched her flesh, then she sighed. She seemed to know I wouldn't go away. When she spoke, her voice was soft. "No Wygnin were on the site planning committee. We bought the land, and built the plants according to our customs. At that point, the Wygnin didn't understand the concept of land purchase."

I noted the use of the word "we." She had been involved with the Third Dynasty, more involved than the records said.

"We built on a haven for nestlings. You understand nestlings?"

"I thought they were a food source."

She shook her head. "They're more than that. They're part of Wygnin society in a way we didn't understand. They become food only after they die. It's the shells that are eaten, not the nestlings themselves. The nestlings themselves are considered sentient."

I felt myself grow cold. "How many were killed?"

She shrugged. "The entire patch. No one knows for sure. We were told, when the Wygnin came to us, that they were letting us off easily by taking our firstborn—Carson's and mine. They could easily take all the children of any-

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one who was connected with the project, but they didn't."

They could have, too. It was the Third Dynasty that acted without regard to local custom, which made it liable to local laws. Over the years, no interstellar court had overturned a ruling in instances like that.

"Carson agreed to it," she said. "He agreed so no one else would suffer. Then we got me out."

"And no one came looking for you until I did."

"That's right," she said.

"I don't think Anetka's going to stop," I said. "I suspect she wants her father to change the will—"

"What?" Sylvy clenched her collar with her right hand, revealing the wrist-top. It was one of the most sophisticated I'd seen.

"Anetka wants control of the Third Dynasty, and I was wondering why her father hadn't done a will favoring her. Now I know. She was probably hoping I couldn't find you so that her father would change the will in her favor."

"He can't," Sylvy said.

"I'm sure he might consider it, if your son's life is at stake," I said. "The Wygnin treat their captives like family—indeed, make them into family, but the techniques they use on adults of other species are—"

"No," she said. "It's too late for Carson to change his will."

She was frowning at me as if I didn't understand anything. And it took me a moment to realize how I'd been used.

Anetka Sobol had tricked me in more ways than I cared to think about. I wasn't half as good as I thought I was. I felt the beginnings of an anger I didn't need. I suppressed it. "He's dead, isn't he?"

Sylvy nodded. "He died three years ago. He installed a personal alarm that notified me the moment his heart stopped. My son has been voting his shares through a proxy program my husband set up during one of his trips here."

I glanced at the wrist-top. No wonder it was so sophisticated. Too sophisticated for a simple administrator. Carson Sobol had given it to her, and through it, had notified her of his death. Had it broken her heart? I couldn't tell, not from three years' distance.

She caught me staring at it, and brought her arm down. I turned away, taking a deep breath as the reality of my situation hit me. Anetka Sobol had outmaneuvered me. She had put me in precisely the kind of case I never wanted.

I was working for the Tracker. I was leading a Disappeared to her death and probably the death of her son. "I don't get it," I said. "If something happens to your son, Anetka still won't inherit."

Sylvy's smile was small. "She inherits by default. My son will disappear, and stop voting the proxy program. She'll set up a new proxy program and continue to vote the shares. I'm sure the Board thinks she's the person behind the votes anyway. No one knows about our son."

"Except for you, and me, and the Wygnin." I closed my eyes. "Anetka had no idea you'd had a son."

"No one did," Sylvy said. "Until now."

I rubbed my nose with my thumb and forefinger. Anetka was good. She had discovered that I was the best and the quickest Retrieval Artist in the business. She had studied me and had known how to reach me. She had also known how to play at being an innocent, how to use my past history to her advantage. She hired me to find her Original, and once I did, she planned to get rid of him. It would have been easy for her too; no hitman, no attempt at killing. She wouldn't have had to do anything except somehow—surreptitiously—let the Wygnin know how to find the Original. They would have taken him in payment for the Third Dynasty's crimes, he would have stopped voting his shares, and she would have controlled the corporation.

Stopping Anetka wasn't going to be easy. Even if I refused to report, even if Sylvy and her son returned to hiding,

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Anetka would continue looking for them.

I had doomed them. If I left this case now, I ensured that one of my colleagues would take it. They would find Sylvy and her son. My colleagues weren't as good as I was, but they were good. And they were smart enough to follow the bits of my trail that I couldn't erase.

The only solution was to get rid of Anetka. I couldn't kill her. But I could think of one other way to stop her.

I opened my eyes. "If I could get Anetka out of the business, and allow you and your son to return home, would you do so?"

Sylvy shook her head. "This is my home," she said. She glanced at the fake adobe walls, the southwestern decor. Her fingers touched a blanket hanging on the wall beside her. "But I can't answer for my son."

"If he doesn't do anything, he'll be running for the rest of his life."

She nodded. "I still can't answer for him. He's an adult now. He makes his own choices."

As we all did.

"Think about it," I said, handing her a card with my chip on it. "I'll be here for two days."

XI

They hired me, of course. What thinking person wouldn't? I had to guarantee that I wouldn't kill Anetka when I got her out of the business—and I did that, by assuring Sylvy that I wasn't now nor would I ever be an assassin—and I had to guarantee that I would get the Wygnin off her son's trail.

I agreed to both conditions, and for the first time in years, I did something other than tracking a Disappeared.

Through channels, I let it drop that I was searching for the real heir to Carson Sobol's considerable fortune. Then I showed some of my actual research—into the daughter's history, the falsified birth date, the inaccurate records. I managed to dump information about Anetka's cloning and her sex change, and I tampered with the records to show that her clone mark had been faked just as her sex had. Alterations, done at birth, made her look like a clone when she really wasn't.

I made sure that my own work on-line looked like sloppy detecting, but I hid the changes I made in other files. I did all of this quickly and thoroughly, and by the time I was done, it appeared as though Carson Sobol had hidden his own heir—originally a son—by making him into a daughter and passing him off as a clone.

At that point, I could have sat back and let events move forward by themselves. But I didn't. This had become personal.

I had to see Anetka one last time.

I set an appointment to hand-deliver my final bill.

XII

This time she was wearing emeralds, an entire sheath covered with them. I had heard that there would be a gala event honoring one of the galaxy's leaders, but I had forgotten that the event would be held in Armstrong, at one of the poshest restaurants on the Moon.

She was sweeping up her long hair, letting it fall just below the mark on the back of her head, when I entered. As she turned, she stabbed an emerald haircomb into the bun at the base of her neck.

"I don't have much time," she said.

"I know." I closed the door. "I wanted give you my final bill."

"You found my sister?" There was a barely concealed excitement in her voice.

"No." The room smelled of an illegal perfume. I was surprised no one had confiscated it when she got off the shuttle and then I realized she probably hadn't taken a shuttle. Even the personal items bag she wore that first day had been part of her act. "I'm resigning."

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She shook her head slightly. "I might have known you would. You have enough money now, so you're going to quit."

"I have enough information now to know you're not the kind of person I relish working for."

She raised her eyebrows. The movement dislodged the tiny emerald attached to her left cheek. She caught it just before it fell to the floor. "I thought you were done investigating me."

"Your father's dead," I said. "He has been for three years, although the Third Dynasty has managed to keep that information secret, knowing the effect his death would have had on galactic confidence in the business."

She stared at me for a moment, clearly surprised. "Only five of us knew that."

"Six," I said.

"You found my mother." She stuck the emerald in its spot.

"You found the alarm. You knew she'd been notified of your father's death."

The emerald wasn't staying on her cheek. Anetka let out a puff of air, then set the entire kit down. "I really didn't appreciate the proxy program," she said. "It notified me of my insignificance an hour after my father breathed his last. It told me to go about my life with my own fortune and abandon my place in the Third Dynasty to my Original."

"Which you didn't do."

"Why should I? I knew more about the business than she ever would."

"Including the Wygnin."

She leaned against the dressing table. "You're much better than I thought."

"And you're a lot more devious than I gave you credit for."

She smiled and tapped her left cheek. "It's the face. Youth still fools."

Perhaps it did. I usually didn't fall for it, though. I couldn't believe I had this time. I had simply thought I was being as cautious as usual. What Anetka Sobol had taught me was that being as cautious as usual wasn't cautious enough.

"Pay me, and I'll get out of here," I said.

"You've found my mother. You may as well tell me where she is."

"So you can turn your Original over to the Wygnin?"

That flat look came back into her eyes. "I wouldn't do that."

"How would you prevent it? The Wygnin have a valid debt."

"It's twenty-seven years old."

"The Wygnin hold onto markers for generations." I paused, then added, "As you well know."

"You can't prove what I do and do not know."

I nodded. "True enough. Information is always tricky. It's so easy to tamper with."

Her eyes narrowed. She was smart, probably one of the smartest people I'd ever come up against. She knew I was referring to something besides our discussion.

"So I'm getting out." I handed her a paper copy of the bill—rare, unnecessary, and expensive. She knew that as well as I did. Then, as soon as she took the paper from my hand, I pressed my wrist-top to send the electronic version. "You owe me money. I expect payment within the hour."

She crumpled the bill. "You'll get it."

"Good." I pulled open the door.

"You know," she said, just loud enough for me to hear, "if you can find my mother, anyone can."

"I've already thought of that," I said, and left.

XIII

The Wygnin came for her later that night, toward the end of the gala. Security tried to stop them until they showed a valid warrant for the heir of Carson Sobol. The entire transaction caused an interstellar incident, and the vidnets were filled with it for days. The Third Dynasty used its attorneys to try to prove that Anetka was the eighth clone, just as everyone thought she was, but the Wygnin didn't believe it.

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The beautiful thing about a clone is that it is a human being. It's simply one whose heritage matches another person's exactly, and whose facts of birth are odder than most. These are facts, yes, but they are facts that can be explained in other ways. The Wygnin simply chose to believe my explanations, not Anetka's. It was the sex change that did it. The Wygnin believed that anyone who would change a child's sex to protect it would also brand it with a clone mark, even if the mark wasn't accurate.

Over time, the lawyers lost all of their appeals, and Anetka disappeared into the Wygnin culture, never to be heard from again.

Oh, of course, the Third Dynasty still believes it's being run by Anetka Sobol voting her shares, as she always has, through a proxy program. Her Original apparently decided not to return to claim his prize. He acts as he always planned to, secretly. Only Sylvy Sobol, her son, and I know the person voting those shares isn't Anetka.

After Anetka's future was sealed, I stopped paying attention to the business of the Third Dynasty. I still don't look. I don't want to know if I have traded one monster for another. Some cold-heartedness is trained—and I can make myself think that Carson Sobol never once treated young Anetka with love, affection, or anything bordering civility—but I am smart enough to know that most cold-heartedness is bred into the genes. Just because Anetka is gone, doesn't mean the Original won't act the same way in similar circumstances.

And what is my excuse for my cold-heartedness? I'd like to say I've never done anything like this before, but I have—always in the name of my client, or a Disappeared. This time, though, this time, I did it for me.

Anetka Sobol had out-thought me, had compromised me, and had made me do the kind of work I'd vowed I'd never do. I let a front use me to open a door that would allow other Trackers find a Disappeared.

People disappear because they want to. They disappear to escape a bad life, or a mistake they've made, or they disappear to save themselves from a horrible death. A person who has disappeared never wants to be found.

I always ignored that simple fact, thinking I knew better. But one man is never a good judge of another, even if he thinks he is.

I tell myself Anetka Sobol would have destroyed her Original if she had had the chance. I tell myself Anetka Sobol was greedy and self-centered. I tell myself Anetka Sobol deserved her fate.

But I can't ignore the fact that when I learned that Anetka Sobol had used me, this case became personal, in a way I would never have expected. Maybe, just maybe, I might have found a different solution, if she hadn't angered me so.

And now she haunts me in the middle of the night. She wakes me out of many a sound sleep. She keeps me restless and questioning. Because I didn't go after her for who she was or what she was planning. I had worked with people far worse than she was. I had met others who had done horrible things, things that made me wonder if they were even human. Anetka Sobol wasn't in their league.

No. I had gone after her for what she had done to me. For what she had made me see about myself. And because I hadn't liked my reflection in the mirror she held up, I destroyed her.

I can't get her back. No one comes back intact from the Wygnin. She will spend the rest of her days there. And I will spend the rest of mine thinking about her.

Some would say that is justice. But I have come to realize, in a universe as complex as this one, justice no longer exists.

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LITTLE BLACK HOLES, ENTROPY, AND ENIGMAS OF OUR EARTH AND UNIVERSE

Mario Rabinowitz, Ph.D.

INTRODUCTION

We can turn to two favored subjects of science fiction to learn more about our enigmatic Universe. One is black holes, objects whose gravitational fields are so strong that everything falls into them, and from which, until recent times, it was thought that nothing—not even light—could get out. The other is entropy, a measure of disorder, which is fundamental to science and plays an important part in science fiction. The classic science fiction short story by Isaac Asimov, "The Last Question," not only deals with the concept of entropy, as do many other stories, but also probes the question of entropy and hence the fate of the Universe. We shall also deal with entropy and other issues that relate to enigmas of our Earth and Universe such as anomalous galaxy rotation, ball lightning, and the accelerated expansion of the Universe.

BLACK HOLES

The Irish political satirist, Jonathan Swift, one of the first science fiction writers, presciently described the rotational periods of the two moons of Mars in his 1726 book, *Gulliver's Travels*, 151 years before they were astronomically discovered by Asaph Hall. Similarly, he seems to have divined black holes in writing, "*All-devouring, all-destroying, Never finding full repast, Till I eat the world at last.*" The latter may be a coincidence. The former is clearly an enigma.

Though black holes were long considered to be the stuff of science fiction, their existence is now firmly established. On an astronomical scale, black holes are the centers of attraction of galaxies, and generate the vast power emitted by quasars, the most luminous objects known in the Universe. There is now ample experimental evidence for heavy (millions to billions of solar masses) and middleweight (hundreds to thousands of solar masses) black holes. Hawking (1971) proposed that the high energies of the Big Bang created little black holes (LBH) in the primordial Universe.

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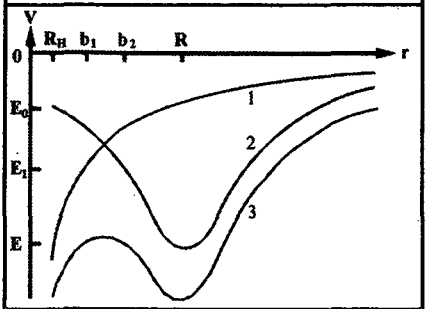
Figure 1



Gravitational Potential Energy Barriers: Curve 1 is the potential of an isolated black hole of Schwarzchild radius R_H and mass M at the origin. Curve 2 is the potential of an isolated mass M_2 centered at R. Curve 3 is the resulting effective potential produced by the combination of M and M_2.

MODELS OF BLACK HOLE RADIATION

Hawking Model

In 1974 Stephen Hawking presented his model of radiation from a non-rotating black hole, similar to Zel'dovich's 1971 model for radiation from a rotating black hole. In his model, due to the large gravitational field and its large gradient, there is a sea of virtual particle pairs near the outside of the black hole that are constantly being created and annihilated. When one member of the pair falls into the hole, the other particle headed outward does not have a partner with which to annihilate. Far from the hole such particles are perceived as radiation that appears to come from the hole. Hawking radiation has not been observed despite over 24 years of searching, and a number of notable scientists have given reasons as to why it may not be observable. Belinsky, an expert in the field, unequivocally concludes that "the effect [Hawking radiation] does not exist."

Beamed Emission Model

In my model, radiation escapes from within a black hole in response to another body. The isolated black hole radiation model of Hawking is an idealized abstraction because there is always another body to distort the gravitational potential and produce beaming of the radiation. The effects of a second body are to lower the gravitational barrier of a black hole and to give the barrier a finite rather than infinite width as shown in Figure 1, so that a particle can escape by tunneling or by going over the top of the lowered barrier. Gravitational field emission is similar to electric field emission of electrons from a metal in that the emission may be controlled, i.e., modulated and beamed.

Black Hole Quantized Gravitational Orbits

In addition to radiation from a black hole, radiation can be emitted from real particles falling into or orbiting a black hole. Charged LBH can act like superheavy atoms with either orbiting electrons or ions depending on the sign of the charge trapped in the hole. Charged or neutral LBH can also form quantized gravitational orbits to form a new kind of matter that is the analog of atomic matter. To obtain the quantized gravitational orbit of a mass m around a LBH of mass M >> m, simple Bohr quantum theory can be applied. The orbital radii are

$$r = \frac{n^2\hbar^2}{Gm^2M}, \qquad (1)$$

where n = 1, 2, 3, . . . is the quantum number, $\hbar$ is Planck's constant / 2π, and G is the universal gravitational constant.

The orbital velocity is

$$v = \frac{GmM}{n\hbar}. \qquad (2)$$

The total energy of m in the orbit of quantum number n is the sum of the kinetic and potential energies

$$E = \tfrac{1}{2}mv^2 + \frac{-GmM}{r} = \frac{-G^2m^3M^2}{2n^2\hbar^2}. \qquad (3)$$

The acceleration is

$$a = \frac{GM}{r^2} = \frac{G^3M^3m^4}{n^4\hbar^4}. \qquad (4)$$

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Table 1

	m, gm	v, cm/sec	r, cm	ν, Hz
1.	2.4×10^{-10}	1.5×10^{10}	3.0×10^{-28}	$\sim 10^{38}$
2.	10^{-21}	6.4×10^{-2}	1.7×10^{-5}	$\sim 10^{4}$
3.	10^{-22}	6.4×10^{-3}	1.7×10^{-3}	~10

Properties of Quantized Gravitational Orbits

It is noteworthy that quite unlike classical (non-quantum) motion in a gravitational field, where the orbiting mass m cancels out, m is dominantly present in this quantum case in apparent contradiction to the Equivalence Principle. Unlike the electromagnetic field, which has dipole radiation, there is no dipole radiation in the gravitational field. In general, gravitational orbits are elliptical ones whose quadrupole moments would radiate when the energy level decreases. For simplicity, the above circular orbit model can be indicative of the frequency of the radiated gravitons:

$$\nu = \frac{\Delta E}{2\pi h} \sim \frac{\pi G^2 m^3 M^2}{\hbar^3} . \qquad (5)$$

Table 1 for a LBH with orbited mass M equals 1 gm shows that the range of the example values easily encompasses, and at the high end surpasses atomic orbitals and frequencies. In the first example, the orbit is more strongly bound than an atomic orbit. The ratio of the electric force to the gravitational force between two electrons ($m_{electron} = 9.1 \times 10^{-28}$ gm) is 4.2×10^{42}, and between two protons ($m_{proton} = 1.7 \times 10^{-24}$ gm) 1.2×10^{36}. So, given enough mass, as in example 1, the total gravitational force exceeds the electrostatic force for a small number of charges. With a velocity of half the velocity of light, it is in the region where a relativistic correction is warranted but not crucial. The orbital radius is twice the horizon radius of the 1 gm LBH, needing a general relativistic correction, until $r > 10R_H$. At the extremely high frequency emitted for such orbits, the graviton mass > ~ m.

The second and third examples are chosen to give gravitational radiation frequencies comparable to those expected from forthcoming astrophysical measurements. With a high enough concentration of excited orbits near the Earth, the signals from LBH quantized gravitational orbits may well compete with signals from distant sources such as neutron stars, binary pulsars, and coalescing black holes. Fortunately, the gravitational wave has details about its source, including its consistency with general relativity, so it may be possible to differentiate souces not only by frequency, but by wave shape.

BLACK HOLES AND ENTROPY OF THE UNIVERSE

The entropy of black holes is tremendously greater than the entropy of ordinary bodies of the same mass. For example, our Sun of mass 2×10^{33} gm has entropy $S \approx 10^{42}$erg / K, whereas a black hole of the same mass has entropy $S_{bh} \approx 10^{60}$erg / K, 10^{18} times higher. If the Universe were 95 percent full of such black holes, there would be 10^{23} of them with an excess entropy of 10^{41} times higher than a universe filled with stars like our Sun. Because entropy strives to be maximized, there is a colossally higher probability that the Big Bang produced black holes dominantly over ordinary matter. Therefore, it appears extremely likely that a large percentage of the mass of at least the primordial Universe was composed of little black holes. Since these are such fundamental findings, we may well ask why these conclusions were not reached some time ago. Let us see why this is so.

Hawking's black holes could not be the dark matter because they would have interfered with the nucleosynthesis of protons and neutrons into deuterium, helium, etc., that occurred in the early Universe. Hawking's LBH cannot have been created in large numbers or they

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would fry the Universe. If LBH radiate according to his model, Hawking concludes that they can *at most* make up one millionth of the matter in the Universe. In my model, LBH are much more quiescent than Hawking's, much less likely to interfere with nucleosynthesis than Hawking's, and thus can account for the dark matter, i.e., up to 95 percent of the mass of the Universe. This in itself is significant; however, equally notable is that my two-body interaction model for LBH radiation also makes LBH viable candidates for *anomalous galaxy rotation, ball lightning*, and the *accelerated expansion of the Universe*.

DARK MATTER

We know what only 5 percent of the accessible Universe is made of. One piece of evidence that there must be 95 percent dark matter or missing mass comes from spiral galaxies. There must be some unseen form of matter whose gravitational attraction is great enough to hold the galaxies together as they rotate, as discovered by the unheralded Vera Rubin in 1983. The missing mass gives the stars approximately constant linear velocities independent of radial distance r, rather than the expected Keplerian velocities $\propto 1 / \sqrt{r}$. Their rate of rotation is so great that they would fly apart if they contained only the stars and gas we can directly perceive.

Since LBH are extremely massive for their minuscule size, they may well explain the missing mass or so-called dark matter of which the Universe is composed, as determined independently by galaxy rotation, galactic clusters, and the average density of the Universe to account for its apparently Euclidean structure. Since they can be small compared with the wavelength of visible light, they will not scatter or occlude light from distant stars. For example, black holes of between 10^{-7} kg and 10^{19} kg have radii between 10^{-34} m and 10^{-8} m, well below visible wavelengths of 4 x 10^{-7} m to 8 x 10^{-7} m. To account for the missing dark matter there would need to be between 10^{61} and 10^{35} such black holes for a universe mass of approximately 10^{54} kg. For our Universe of radius 15 x 10^{9} light-years, this would require an average density of between 10^{30} and 10^{4} black holes per cubic light-year (10^{48} m^3) and more than this near the over 400 billion galaxies in the Universe, due to gravitational attraction. This is many, many orders of magnitude larger than permitted for Hawking's extremely radiative black holes. There may be sufficient numbers of little black holes in the region of the Earth for their presence to be displayed, and they can manifest themselves as ball lightning.

BALL LIGHTNING

Ball lightning is one of the few long-known and widely-accepted natural phenomena which are still unexplained. It is easy to see why the scientific community has not considered LBH as the core power source of ball lightning because Hawking's LBH radiate at a devastatingly high rate in all directions that would hardly go unnoticed. Prior to the awareness that black holes can radiate, their presence in the Earth would have been considered highly unlikely, as the Earth would have been devoured after about a million years, leaving a black hole of 1 cm radius. But the Earth has existed for over four billion years. For my new view of LBH, the downward directed radiation between the hole and the Earth can provide levitation, with a small horizontal component providing mobility, and the holes radiate considerably less than Hawking's. When they get so small that there would be appreciable radiation, the radially outward radiation reaction force propels them away from the Earth. For these and many other reasons that we shall see, they are excellent candidates to be the source of ball lightning.

A powerfully radiating LBH is not directly visible because the frequencies are so high. LBH become visible indirectly as ball lightning in the surround-

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ing air by excitation and ionization of the air molecules and atoms in interaction with a charged LBH which can act like a super-heavy atom or ion. LBH as the source of ball lightning meet 17 criteria for assessing ball lightning models in general, whereas most other models meet only a few criteria.

Two of the most salient criteria are that ball lightning can penetrate through virtually any substance, and requires no external energy source. LBH of approximately 1 gm have radii approximately 10^{-28} cm (10^{15} times smaller than a proton) and could easily penetrate through any material. The fact that ball lightning can exist within a closed conducting metal structure (Faraday cage) dictates against models that depend on external energy from electrical currents or electromagnetic radiation that is shielded by a conductor. It is possible for a LBH to easily manifest itself as ball lightning, inside closed highly conducting structures such as airplanes, due to its gravitationally stored energy. Entry into airborne craft has occurred on a number of separate occasions, and is well documented.

OTHER TERRESTRIAL AND CELESTIAL MANIFESTATIONS

Reasonable Speculations

Many geophysical and astrophysical processes are not yet well understood. LBH may be a link that relates to these processes such as volcanoes, gravitational field anomalies, earthquakes, tornadoes, planetary seeding, rings of Saturn, and copious excess heat generation in planets like Jupiter and its moons. There could be profound implications for Earth and planetary science if it could be established that LBH are present in and on the Earth. For example, whereas the Earth's overall density is 5.5 gm/cm^3, the Earth's lithosphere (50 miles in from the surface) has a measured density of approximately 2.7 gm/cm^3. This difference in density has been generally assumed to be due to molten iron filling the Earth's core. LBH in the core could help in part to account for both the increased density and the total outward heat flow from the interior of the Earth, as well as other planets. Jupiter, for example, has a very large interior production of heat. It is thought that some of its moons are heated by tidal friction in interacting with Jupiter's gravitational field, but there are significant differences in this effect for the various moons. This moderate heating makes them conducive to sustaining life.

Hawking was among the first to suggest that small black holes gobbling up neutrinos in stellar objects such as our Sun might help to explain the solar neutrino deficit problem. In addition, others such as Trofimenko have discussed the possibility that LBH are involved in geophysical and astrophysical phenomena, but did not reflect on ball lightning, nor the ramifications of LBH radiation and/or the time for LBH to devour their hosts. It is easy to see why LBH have not been considered as the core power source of ball lightning because Hawking's LBH radiate at a disastrously high rate.

It has not been easy to conclude that LBH are present near or in astronomical bodies such as our Earth and other planets. There are two extremes with respect to this question, and they both have problems. One is the pre-Hawking radiation view which would permit the Universe to be filled with a large percentage of LBH, but has the problem that the LBH would gobble up any hosts they inhabit. The other is the post-Hawking radiation view which would limit the Universe to have only about one-millionth of its mass filled with LBH because there would otherwise be too much Hawking radiation. My model permits up to 95 percent of the Universe to be filled with LBH, because their radiation is relatively quiescent, and yet lets them evaporate away near or in astronomical bodies before these bodies are devoured.

My model of LBH radiation permits more realistic speculation of how LBH

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might be gathered. Harvesting LBH might be no more difficult than mining asteroids that have LBH in them from the asteroid belt. An entire asteroid could be towed in; an asteroid could be whittled down to a manageable size to carry on board the spacecraft; or the LBH might be shaken out of the asteroid, and captured in a small dense sphere. Another possibilty might be to charge up LBH and carefully maneuver them with an electric field.

The Tunguska Event

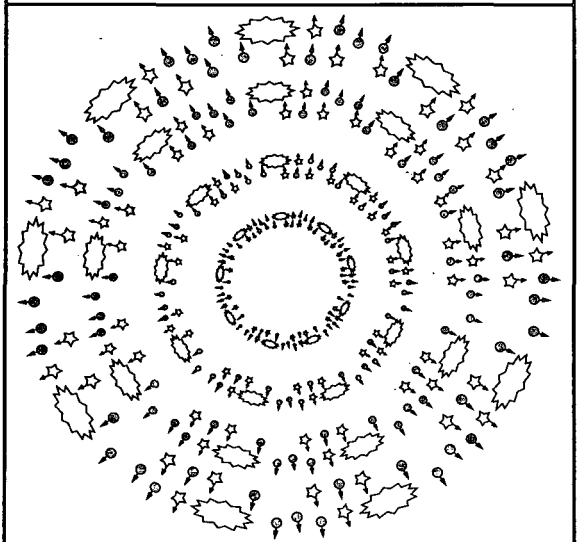
Our planet has endured countless horrific explosions from its inception, four to five billion years ago, to the present. The early Earth survived catastrophes such as ocean-boiling bombardment from outer space debris and a naturally occurring nuclear explosion, but there is none more perplexing than the devastation of the Tunguska area of central Siberia. Bewilderment persists to this day, despite the fact that there were large numbers of eyewitnesses and we know precisely when and where this mysterious gigantic explosion took place. On June 30, 1908, a brilliant ball of fire crossed the sky and exploded in the sky with a blast equivalent to 30 million tons of TNT. More cataclysmic than a hydrogen bomb, the force flattened trees, causing them to point radially outward within a 40-mile diameter circle; and hurled creatures like horses to the ground more than 400 miles away in the area of Kansk.

One of the many speculations that have been considered over the years is that this destruction of an area of more than 1,200 square miles was caused by a black hole. This seems highly unlikely from my model of black hole radiation which is beamed and relatively quiescent compared with Hawking's. Even for the much more devastating isotropic Hawking radiation, one would not expect a high enough sudden power release on a scale consistent with the Tunguska event since, both for his model and mine, large black holes radiate very little. They also don't quickly consume objects that are considerably more voluminous than themselves, and a black hole might still be ingesting part of Siberia. Furthermore, the treetops would have pointed radially inward, rather than radially outward, unless they were toppled by the outward blast rather than by gravitational attraction.

ACCELERATED EXPANSION OF THE UNIVERSE

The discovery of the accelerated expansion of the Universe was totally unanticipated, and has previously had no explanation. It calls long-standing cosmological theories into question. The implication is that the Universe is older,

Figure 2



Little black holes (shown in black) causing the accelerated expansion of the Universe.

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bigger, and less dense than previously thought. It may shed light on the enigma that some stars appear to be older than the previously accepted age of the Universe. One viable explanation that emerges is related to acceleration due to radiation pressure from LBH propelling them outward. The new discoveries radically change our concept of what drives the macrocosm, and initiate a fundamentally new quest for the laws that govern the Universe on a large scale.

If LBH represent a substantial fraction of the missing mass of the Universe, then their radially inward-directed radiation is a good candidate model for the accelerated expansion of the Universe due to interaction with the Universe as the second body. The result is an outward force on the LBH and other stellar objects that the LBH pull with them gravitationally as depicted in Figure 2.

CONCLUSION

Many profound consequences can result from a change in the model of black hole radiation. It is interesting and almost ironic that black holes may be the dark matter of the Universe. This is about as dark as the matter could get. In defying the conventional wisdom of our everyday senses, Copernicus helped humanity to define the Earth and its non-central place in the cosmos. Discovery of the nature of dark matter will help to define what the Universe is made of; and reveal the invisible particles carrying the gravitational glue that holds the Universe, galaxies, and clusters of galaxies together and determines the curvature of space. If any one of the connections I have made to LBH is confirmed, then it would be highly likely that my model is correct.■

Acknowledgment

Thanks are due to a half-century devotee of *Analog,* Robert D. Weaver; and to my son Ben, and John Essel, without whose urging and help this article would not have been written.

About the Author

Dr. Mario Rabinowitz received B.S. and M.S. degrees in Physics from the University of Washington in 1959 and 1960. He was awarded a Ph.D. in Physics by Washington State University in 1963. He is CEO of Armor Research. He was Senior Scientist at the Electric Power Research Institute (EPRI) for 22 years. Prior to joining EPRI in 1974, he was at Stanford University's SLAC for seven years. He has been an Adjunct Professor at Georgia Insitute of Technology, Univ. of Houston, Virginia Commonwealth Univ., Case-Western Univ., and Boston Univ. He has also taught at Stanford Univ., San Jose State Univ., and San Jose City College. He received the 1992 Washington State Univ. Alumni Achievement Award. He was the first to show that a single high-altitude nuclear burst would not black out the U.S. He has 36 U. S. patents, and many more in nine other countries. He has published over 140 scientific papers on such subjects as beamed black hole radiation, superconductivity, classical tunneling, fusion, physical electronics, electrical discharges, surface physics, and vacuum physics. He has written four articles for the *Encyclopedia of Science and Technology.* Two are feature articles on Advanced Electric Power Transmission, and on the Nuclear Electromagnetic Pulse, in the 1981 and 1986 Yearbooks respectively.

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Liberty is the only thing you can't have unless you give it to others.

— William Allan White

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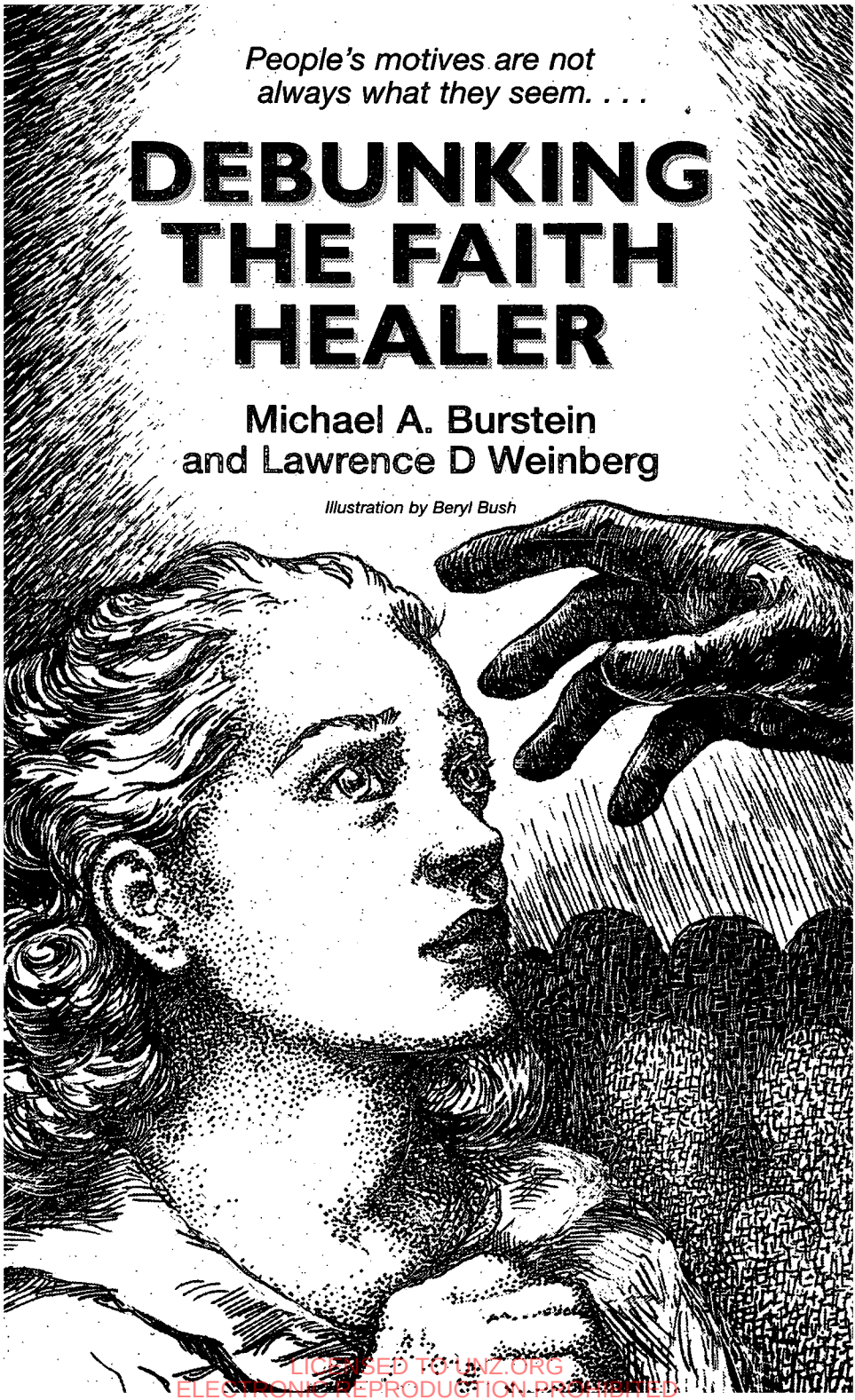
People's motives are not always what they seem. . . .

DEBUNKING THE FAITH HEALER

Michael A. Burstein
and Lawrence D Weinberg

Illustration by Beryl Bush



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February 27, 1982

For almost thirty years I've kept my promise to Dr. Weiss. The story I wrote in 1955 was about a madman who, for some inexplicable reason, had the power to heal people, and whose power drove him to suicide. It was an easy promise to keep, because even with Weiss asserting that he had come from the future to save the world, I still could not bring myself to believe it. So I wrote my story of a madman.

But then, in the 1970s, I came across a name which I thought I'd never hear: Leonard Hayflick. Weiss was for real after all. For most of my life, I had put him out of my mind, and to be honest, I probably shouldn't be writing this down even now. I can't publish it. I shouldn't publish it. But I'm dying, of cancer ironically enough, and I need to get the truth put down on paper before I'm no longer able to. Hopefully, I'll remember to burn this before I die.

But if I don't—John, if you find these papers in my personal effects when going through them—for everyone's sake, stop reading now. Burn them yourself, or seal them in an envelope, not to be opened until well into the twenty-second century. It would be too dangerous to do otherwise.

The obvious place to start is with my father and his faith. Since my father's faith came to him late in his life, I obviously never knew him when he was a young agnostic, and so I always recall him as a very religious man. His faith came to him when he survived his second heart attack, just a few years after my birth in 1930. My mother and he had prayed for his recovery, and when his condition improved, they credited their faith much more than they credited modern medicine. So my parents raised me to believe in and accept salvation through Jesus. As a typical good child I accepted all of it, believing what my parents told me.

My mother was a regular Sunday churchgoer, and always made a big deal out of Christmas, Good Friday, and Easter, but it was my father who was the driving force behind the faith in our home. When he was diagnosed with pancreatic cancer he became even more devout. I was eleven years old that summer. For the first few weeks, he sat around the house in his underwear, moving slowly from room to room, listening to the radio and eating very little. A little later on he stopped his moping, but he shocked me by staying home on Sundays when my mother and I went to church, and, for a short time, I thought he had lost his faith. But soon after, I discovered that he had merely transferred his faith from our family preacher to another sort.

Shortly after I turned twelve my father took me to my first open-tent church meeting. The preacher stood on a raised platform dressed in a white cotton robe, raising his hands and invoking the Lord's name. It seemed so phony but I didn't want to disrespect my father, so I quietly hallelued and amened with everybody else.

After a while I forgot my disdain and really started getting into it, screaming "Amen!" at the top of my lungs. Then my father told me he was going up to the stage and the preacher was going to heal him. My father slowly walked up to the stage, carefully taking the steps one at a time. He approached the preacher, who asked, "Are you a true believer in our Lord and Savior?"

"Yes," my father said softly.

"Do you believe that He has the power to heal you of your afflictions?"

"Yes." He spoke more loudly now.

"You have to believe with all your heart, with all your soul! The Lord knows, my son. You have to believe."

His voice became a shout which filled the tent, and blasted my last remaining wall of doubt into crumbled masonry. "I believe! Praise the Lord!"

Then the preacher put his hands on my father's forehead and my father fell to the floor. He wasn't healed, but it didn't

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stop him from donating money to the preacher.

This is what he ended up doing every Sunday, and since my mother refused to abandon Reverend Hutchinson, my father would take me with him for moral support. He would drive hundreds of miles to see different preachers. The tents were different colors, but the prayer was the same. The requirements were the same. Dad believed, made his donation, but he was never healed.

When he was finally hospitalized, his greatest regret was that he couldn't go to the open-tent meetings anymore. He didn't miss walks in the park, playing ball, or whatever activities cancer victims are supposed to miss. All he missed, all he talked about on his deathbed, were those meetings.

The week before he died, I made my last visit. My mother wouldn't let me visit him when he went into the coma. His last words to me were, "Robert, go to church and say a prayer. My faith wasn't good enough. Maybe yours will be."

After my father's funeral, Reverend Hutchinson tried to comfort me by saying that my father was in a better place. "Then why did he keep going to you people to be healed?" I asked. "If heaven is so good, how come the only way to stay out of it is to have faith?" I knew I was being unfair to Reverend Hutchinson; he had never approved of my father's sudden interest in the powers of faith healing, and had even come to the house once to lure him back to the community. But at that moment, I looked at Reverend Hutchinson and all I could see was that first preacher in his white robe, taking my father's money and giving back lies in return.

Reading back over what I've just written, I realize that I've left out any mention of what else was going on in the world at the time. It is true that I was born at the start of the Depression; and it is also true that around the same time my father was going from healer to healer, the country was much more concerned with World War II than with anything else. But to be honest, none of that really mattered to me. I didn't really understand what the Depression meant; to me, life had always been as poor as it was. And when my father was finally diagnosed in 1941, the bombing of Pearl Harbor later that year was practically an anticlimax. After all, he wasn't going to be fighting in the war, and neither was I.

In short, my life was more influenced by my experience with a dying father and his search for faith healers than anything else. So although I chose to study English literature in college, it was mostly from a lack of interest in anything else. The course of my life was pretty much determined by my disdain and disgust for con artists, which led me to investigative journalism as a career. This was long before Woodward and Bernstein broke the Watergate scandal, but investigative journalism had been around since before I was born in one form or another. I concentrated on revealing hoaxes and scams, with one exception.

I stayed away from faith healers.

It was after I had been at my job for a few years that my editor, Patricia Randall, who had gotten her position during the war, called me in to discuss a story about a faith healer down in Missouri.

"This is definitely one for the books," she said once I was settled in her office. She passed over a folder with news clippings from various small-town newspapers, and I began paging through it.

"The man's name—or at least the name he's using—is Reverend William Harvey," she said, which gave me a slight chuckle. "He's been working all over the Midwest for the past six months or so. Three weeks ago he did his thing in a tent near Indianola, Iowa, and he's currently outside of Marshfield, Missouri."

I nodded as the articles I was reading confirmed what she said. "What's so special about him?"

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"Look at the four articles clipped at the back."

I turned to the back. The four articles were puff pieces, practically just congratulatory messages to four regular folks recovering from cancer in four different small towns. I looked up when I was done. "So?"

"All four of those people had their cancers go into remission after a visit to Harvey's tent."

I shrugged. "Coincidence."

Patty gave me a bemused smile. "Of course it's coincidence. But you have to admit that it's bad timing. If other people start getting the idea that this guy really cured them—"

"I understand." I lifted the folder. "Do you have anything for me besides this?"

Patty nodded. "One of our sources saw him operate in Osceola. Said his routine is different from that of other faith healers. Most faith healers will allow anyone in the audience to come up for a healing. Harvey only heals the ones he names in advance. Others get turned down."

Memories of dozens of tent services flooded my mind. "That does seem strange," I admitted.

"Probably, but I want you to find out how this guy chooses names. Maybe he's getting their medical records in advance or something like that. That could explain why he's batting a thousand."

I nodded my head and flipped through the folder one more time. "There's no photograph," I said.

She shook her head. "Harvey apparently tries to stay out of the spotlight."

Now that was even stranger; the faith healers I remembered depended on publicity, and would never eschew it. I raised an eyebrow. "Is this a straightforward investigation, or are we talking about undercover work again?"

"He probably won't talk to you as a reporter, so you'll have to go as a regular guy. Just don't get in trouble like you did the last time."

"Hey," I protested, "that wasn't my fault. If you recall, my contact—"

"Bob, just get the story. Be careful."

I made a few phone calls to people down in Indianola and Marshfield before I booked a flight to Des Moines. I struck paydirt with one call. A guy from Iowa named Sam had gone to see Reverend Harvey when he pitched his tent near Indianola, and he had found the service atypical. Apparently, Reverend Harvey didn't seem like much of a preacher to him; it was mostly the audience's enthusiasm that had kept the service going. Even worse, Sam confirmed what my editor had said about Harvey's routine. Harvey had not called people up to the stage unless he specifically named them, and Sam had wanted to have a wart removed. If his report could be believed, Sam had gone to see Harvey after the service for a cure, and Harvey's men had actually turned him away.

But Sam had one extra twist to add, which struck me as weirder than anything else. Harvey had never, not once, asked for money during the service. Sam noted that there had been a collection box at the tent entrance, but the reverend had never passed it around or demanded a donation.

My flight from Newark to Des Moines left that afternoon. When I got to Des Moines, I rented a car and drove to Indianola. The town was a useless waste of time. I went to a park, the library, a bar, and although a lot of people talked about Harvey, no one knew where he came from or where he had gone. The only extra piece of information I picked up was that Harvey had two men working for him. One man, very tall with a mustache, had arrived with Harvey. The other was a drifter who Harvey picked up in the bus station in Indianola, and taken with him when he had left.

It was late when I finished up, and I felt hot and tired, so I checked into a motel and faded off to sleep. The next morning I woke up early, ate a quick breakfast, and drove the three hundred and fifty miles to Marshfield, Missouri.

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When I got to Marshfield, I asked several people at a convenience store about the faith healer. A couple of people said they knew someone who had gone to him and been cured. One man told me he was gone.

"Gone."

"Yep. Headed down south two days ago."

"Do you have any idea where he might be?"

He told me the road the faith healer had taken, but added, "I don't know how far he went."

I thanked the man and used a pay phone to call the office. When I reached Patty, she cut right to the chase.

"Harvey's moved down to Gainesville," she said. "There was an ad in a circular announcing his first healing, tonight."

"You could have saved me a lot of trouble," I said.

"Think of it as local color for the article."

I ate lunch at a diner, drove down to Gainesville, and spotted the tent being set up just outside the town. Relatively speaking, it was small. It couldn't hold more than two or three hundred people, nothing like some of the huge tents my father took me to when I was a kid. I also noticed a smaller tent attached to the back.

I parked my car next to a few others in what looked like a makeshift parking lot. I felt hot, so I loosened my tie and removed my fedora before I approached one of the workmen. He was pulling on a rope to hook the tent into the ground. "Hi, friend," I said as easily as I could. "When's the next show?"

He gave me an offended look, and stood up straight. "No show, buddy. This here's a tent for a *preacher.*" He said it like the word was magical.

I kept my patience. "Then when is the next service?"

He wiped the sweat off his brow, and kept pulling the rope. "I don't know. I just offered to help them rig up the tent. My wife has leukemia, and they say he cures people. I'm hoping that if I help rig the tent he'll look at her." He tied the rope down, then pointed off to the side. "The guy giving orders is over there. You might ask him."

"Thanks."

The "guy giving orders" was the tall man with a mustache who had been described to me before. He looked vaguely familiar, but I couldn't place him. I waited until he finished telling another workman what to do, then approached him.

"Hello, friend. I was wondering when the next service is going to be."

"Next? We just got here."

Damn; I should have been more careful. "I mean, when are the services going to begin? My wife is very ill and I was hoping to bring her here. She has very little time left."

He shook his head. "Reverend Harvey is very much against people who are too sick to travel coming to the services."

I should have guessed as much. "You don't suppose he'd mind if I come, do you?"

He shook his head again. "Not at all. The first service is tonight at seven. Hope your wife gets better."

"Thank you." I looked around. "Do you need any more men to rig up the tent?"

"Sure," he said, smiling. "We can always use an extra pair of hands."

"Thanks. Name's Robert, by the way. Robert Smith." I extended my hand, and he shook it.

"Arnold Hugh," he said, and his face clicked for me. Hugh was a mobster, convicted in Chicago back in the 1920s for bootlegging. The case was far enough in the past that he was probably out legitimately, but it made me wonder more about Harvey's operation. Perhaps the two of them had met in jail and created this scheme together.

Hugh looked around, then said, "Looks like we're about done setting up the tent. Why don't you see what needs doing inside? It'll be cooler, anyway."

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I nodded and went inside. I spotted four men and two women setting up folding chairs, and I joined in.

We got to talking, and sure enough, all had the same story. Either they were seriously ill or somebody close to them was. They did have a little more information for me. Besides Hugh, the only other person who came with Reverend Harvey was a man named Elliot Gordon. I figured him for the homeless man Harvey picked up at the bus station in Indianola.

As we continued to unfold chairs, I kept looking at the flap that led from the main tent into the smaller tent. I pointed to it and asked one of the men, "What's in there?"

The man shrugged. "Dunno. No one asked us to set anything up in there."

I nodded. That was probably where I needed to go. I figured I'd wait until the service, though, before taking a look.

As Hugh had said, the first service started that night at seven. Having no place better to go, I hung around in the front row, watching people arrive and getting to know the residents of this little town.

Surprisingly, very few of them knew exactly who the preacher was. Some had heard of him from friends and relatives of the people he'd healed in Indianola, Osceola, or a few other towns. They'd heard that he would come into the town for a few days, heal a small handful of people, and then move on. But most of them were just there because it was something to do in a place that never got much excitement. They were even fascinated by my presence, a stranger from elsewhere.

By seven o'clock every seat in the tent was occupied. The minutes ticked away, and tension filled the air, until finally, at five past, Reverend William Harvey parted the flap from the small tent and ascended to the stage. The audience immediately fell silent.

Harvey did not look like any of the preachers I remembered from my childhood. He did not wear a white jacket or a robe, nor did he have those chiseled, handsome features that seemed to be a defining characteristic of the faith healer. He was an average-looking man in his forties or fifties, with a pot-belly, graying hair, and round glasses. He wore a plain, simple dark blue suit that desperately needed ironing. He also wore very thin black gloves.

When he reached the center of the stage, where the microphone stand had been placed, a spotlight shone upon him. He began to speak, and I could not reconcile his style with that of the preachers of my memories. Harvey talked into the microphone almost as if he was about to take a bite out of it, and he rarely spoke towards the audience. He mumbled, relying on the speaker system to carry his reedy voice throughout the tent.

"How many of you have come here because you are sick? How many of you have come because you have no hope? How many of you have come here to ask the Lord to return your hope? How many of you have come here to ask the Lord to heal you?"

Another spotlight shone upon the audience.

A few people in the crowd began yelling; I recognized the voices as those of the folks who helped set up the tent. "Amen!" "I believe!" "I'm here!" "I trust Jesus!" "Please heal me!"

Harvey gestured for the crowd to quiet down. "Ladies and gentlemen, I do not heal you. I am only the messenger of the Lord. Only the Lord can cure you. Only the Lord can take away your pain. Only the Lord can give you back your health. Praise the Lord!" He raised his arms emotionally, but a bit reluctantly, as if he was a bad actor following a script.

From various parts of the tent, people echoed, "Praise the Lord!"

Harvey continued. "I am only a messenger of the Lord. I have a gift. The

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Lord tells me those whom He will heal. I do not understand why the Lord chose me. I just do his work." Harvey was definitely very uncomfortable up there, nothing like the natural showmen who were the preachers of my youth.

Still, more of the crowd began getting into it. I heard "Amen!" from many more people.

"Now, ladies and gentlemen, brothers and sisters. I will ask some of you to come up here and accept the healing power of the Lord." Harvey closed his eyes slowly, and just when I thought he had fallen asleep, they shot open. "Jennifer MacDougal!" he called. "Come up here and accept the healing power of the Lord."

A brunette woman whose hair was just beginning to be flecked with white got out of her seat and walked up to the stage. She appeared to be in her forties. She walked slowly, pausing as she went up each step. She walked up to Harvey and opened her mouth, but he motioned to her to be silent.

Harvey put his hands on her head for about five seconds and then said, "You are healed, my child. Praise the Lord."

A choir, probably from one of the local churches, began singing "Bringing in the Sheaves," and Harvey walked offstage. I watched him carefully as he went back through the flap into the smaller tent.

That was how things progressed throughout the service. Harvey would come back out after the singing, say a few words, and call someone up to be healed. A few times he wouldn't even do that. The choir would begin singing, and Harvey would duck out again.

The fourth time Harvey came back out I had already wiggled my way to the exit flap. By the time he was beginning his spiel, I had worked my way around to the back of the small tent. I looked around, saw no one, and crawled under the tarp.

The inside of the tent was furnished like a small combination bedroom and office. There was a desk, a filing cabinet, a bed, a dresser, and a trunk. I was closest to the filing cabinet, so I tried it first. Locked. Then I opened the trunk.

It was crammed full of gloves, the same black gloves that Harvey was wearing tonight. I was stunned by the sheer absurdity of it all and didn't notice that the choir had started singing.

Harvey walked in and spotted me; I noticed that he had begun removing his gloves. He glared at me. "Who are you? What are you doing in here?"

"I wanted to talk to you about my wife."

He tossed his gloves into the trunk and slammed it shut. "This area is private. You're going to have to leave."

I walked around the trunk, keeping my back to the tent. My eyes darted around, and I noticed some papers sitting on the desk.

"I'm sorry, Reverend," I said, as I strained to get a better look at the desk, "but I just wanted to talk to you about my wife. She's very sick and I was hoping you could come visit her in the hospital."

The anger in his face briefly melted into compassion. "I'm sorry, but I don't visit people in the hospital. I don't choose who I heal. It is up to the Lord. Now please leave."

I took a step closer to the desk, which was in the direction of the exit flap. "I understand, Reverend, but she's very important to me. We have some money. I'd be willing to make a donation to your ministry if you would just come see her. It would mean an awful lot to her." As I talked, I glanced down, facing the floor but with my eyes looking off at a slant. The papers looked like medical records.

"I told you that isn't how I work. It's not in my power. You'll have to leave."

I nodded, said, "I understand," and turned to leave. I had one last chance to read the papers, and I managed to make out one name before I walked out: Jennifer MacDougal, the first person Harvey had "healed" tonight.

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Although it was already very late, I found a motel with a vacancy and checked in. Then I tried to put together what I had seen tonight. My first thought was that Harvey somehow managed to steal people's medical records, and then could tell them their diagnoses during his routine. That made sense from the perspective of getting people to believe in him, but it didn't explain his success record. Perhaps he stole the records of people in remission and then "cured" them before their doctors informed them of their improvement? No, that made no sense either; I imagined that the first thing a doctor would want to tell a patient was the good news. And if you already knew you were well again, what would be the point of going to a faith healer?

I had trouble getting to sleep.

The next morning I decided that a slightly different investigation would help. I had a few names to pick from, and I settled on the one that had most stayed in my mind: Jennifer MacDougal. I made a few phone calls to get some information on her, and then I called her at home. Posing as an insurance agent, I got her to tell me the name of her doctor and the hospital where he practiced. She went to a large city hospital once a month for radiation therapy, but she also saw a local cancer specialist named Dr. John Schlessinger. I called his office and managed to make an appointment to see him that afternoon. Then I made a quick call to Patty.

After lunch, I went to see the doctor. The receptionist let me into his office only ten minutes late. The office was spartan: one metal desk, two wooden chairs, and a filing cabinet. I sat in one chair and waited, and when Dr. Schlessinger walked in I stood up to greet him. He was an older man of average height, with eyes hidden behind thick glasses. He reminded me of somebody's favorite uncle.

"You must be Peter Livingston," he said, greeting me with the fake name I had given his secretary. We shook hands. "My receptionist said you wanted to see me about an article?"

I nodded. "Yes, I'm with the St. Louis *Tribune*." I passed over one of my fake press cards as he sat down. "I'm a science reporter. I'm doing a report on terminally ill cancer patients, and the different sort of therapies they receive all over the state."

He glanced at the card, nodded, and handed it back. "So what can I do for you?"

"I'd like to interview you for my article, if you have the time."

It wasn't too difficult to get him to talk. I pulled out a notebook and pretended to take notes, as he gave long answers to my few leading questions. Dr. Schlessinger bemoaned the fact that his hospital didn't have enough money for the best treatments, and saw this interview as a way to let the politicians and bureaucrats know. Interestingly enough, he also had some choice words to say about faith healers; apparently, some of his patients had been seeking out alternative forms of treatment, and he felt it was his mission to warn people about putting too much faith in anything other than modern medicine.

Finally, a nurse knocked on the door, and told the doctor that he had an important phone call. He turned to me and asked, "Would you excuse me for a few minutes?"

"Certainly. It'll give me a chance to go over these notes." Dr. Schlessinger nodded and left the room.

It had gone off exactly as I'd planned it; Patty had come through again. The doctor would be out of the office for a few minutes with the emergency we'd manufactured, just barely enough time. The moment he left the room I jumped up and opened his filing cabinet. In the city it would probably be locked, but this was Gainesville, Missouri, so I was lucky. The top drawer was A-M, and in the back, I easily found MacDougal's file.

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I pulled it out, laid it on the desk, and began reading.

MacDougal was terminal; Dr. Schlessinger gave her only a few months left to live.

Confused, I put the file back, and thought about it while waiting for the doctor to return. It made absolutely no sense. If Harvey had managed to get her file, and he knew she was about to die, why would he call her name out as one he could heal? How could this explain the people who had recovered?

I had one more idea, and after concluding the interview I called the hospital where MacDougal went for her radiation therapy. I pretended to be calling from Schlessinger's office, and said I needed to update our files on Jennifer MacDougal and what was their latest report?

They confirmed that Schlessinger's file was up to date. MacDougal would die within the year.

I hung up the phone, more angry than confused. No matter what had happened to other patients who came to Harvey, I had concrete evidence that MacDougal had no real hope. And yet Harvey had claimed to cure her, and I could imagine her family believing all was now fine, thinking that they had years left to spend with her, until . . .

I would not allow Harvey to do to Jennifer MacDougal's family what so many faith healers had done to my mother and me.

That night I waited until after the service. After the tent cleared out, Harvey drove off with Hugh and Gordon to get a late dinner. I made sure no one else was around, and then I passed through the large tent and into the small tent.

The filing cabinet was locked, just like it had been yesterday, but now I had more time. It was a cheap lock and easy to pick, and as soon as I had it open, I began looking through the files. Harvey had them organized by place rather than person, but all that required was for me to look for Gainesville files first. I pulled out the stack, found the file for Jennifer MacDougal which I had seen last night, and began reading.

It was not the same file as that in Dr. Schlessinger's office. For one thing, right across the top, this file read "Cause of Death: Cervical Cancer."

I started going through all the files for Gainesville. Each one of them listed a cause of death. Leukemia. Pancreatic cancer. Breast cancer. That made no sense. All these people were still alive; I had heard most of the names last night. What the hell was going on here?

I turned back to MacDougal's record and started going over it more carefully. It looked exactly like the one in Dr. Schlessinger's office. It stated when she had first come to see him, the development of her cancer, her radiation treatments, the spontaneous remission—

The spontaneous remission?

According to this record, MacDougal's cancer had gone into remission. But the date that this happened was a few months in the future. I turned back to the front and for the first time read the date of death. April 13, 1965. Ten years in the future.

Quickly, I looked through the other records. They were all like that. Cancer patients whose records claimed that their cancer had gone into remission this year, but at a date a few months hence. And with dates of death recorded as being in the 1960s and 1970s. In the future.

I was so perplexed I barely registered the sound of a car pulling up. By the time I had thought to hide, Reverend Harvey had barged into the tent, with Arnold Hugh and Elliot Gordon close behind.

"Who are you?" he shouted, and then he got a look at my face. "You were in here yesterday. About your wife." Then he got a look at his open filing cabinet, and I knew that my cover story was blown.

"You're not here about your wife, are you." It was said as a statement and not as a question.

I shook my head slowly, looking

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around the tent for a way to escape. I didn't know anything about Gordon, but I did know that Hugh had shot people before. And the two of them were giving me some very mean looks.

On the other hand, Harvey didn't look angry anymore, just worried.

"Well," he said. "I guess we need to talk." He turned to the other two men, put his hands on their shoulders, and smiled. "Guys, you can leave us alone for a while." They nodded at him and kept staring at me as they shuffled past me into the main tent.

Harvey came over to the desk, looked at the records I had strewn about, shook his head, and sighed. "Just a few more weeks . . ." he murmured.

"In a few more days, I'll have you exposed to the world," I said.

He got a pained look on his face. "Exposed as what?" he asked, as he sat behind the desk. He tried to pull the files together, but I slammed my hands down on them before he could.

"As—as a fake faith healer, of course."

He leaned back with a puzzled expression. "A fake? You really don't understand what these are, do you?"

I shrugged. He was right; I still wasn't sure what was going on, but I didn't want him to know that. "Stolen medical records. You find out what kind of cancer people have, and then call them up at your prayer meetings."

He nodded. "And then I cure them. Or haven't you discovered that yet? I presume you're a reporter."

I changed tactics. "What about the money?"

"I don't ask for money. You know that, you were here last night."

"You have a box out front."

"Sure I do. Some people want to donate. And I do have expenses. But I never tell people that giving me money will lead to a cure."

I was silent, and he spoke again. "Mind telling me who you are?"

"My name's Bob, and that's all you need to know."

He sighed. "Look, if you're a reporter, you must have already discovered that the people I cure do recover. So since I'm not a fake, you don't have a story."

Something clicked. "You must think I'm an idiot."

"Why do you say that?"

"Because if you're for real, it's a much bigger story."

His face paled. "I don't think so."

"Of course it is. First real faith healer in history. Scientifically provable. It would put you on the map."

"No!"

I waited a moment, then asked, "So what are you hiding?"

"If I tell you, will you swear not to write a story about me?"

"You mean, that as a legitimate faith healer, you don't want any publicity."

"Yes."

"Why not? If you were legitimate, I'd imagine you'd want people to come from across the country. Imagine how many lives you'd touch."

"No! I don't want to touch lives. I want to have as little impact as possible, and if you run your story that will ruin everything. I just want to run small services." He looked at a calendar hanging on the wall. "It's almost over, anyway."

"What do you mean, it's almost over?"

"Look. If I explain everything to you, would you swear not to write the story?"

I shook my head. "I'm going to publish something. If you tell me the truth, I plan to use it."

"Yes, but I think once I tell you, you won't want to publish it." Harvey paused. "Well, you'll want to publish it, but you'll understand that it's important not to."

"So I would get to decide whether I publish the story."

"Yes. There is one catch."

"What is it?"

"You'd have to swear on what you hold honorable to listen to the whole story with an open mind. And that you won't publish the story even if you want

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to, if you acknowledge that publishing the story would do more harm than good."

"But I get to decide if I'm going to publish the story?"

"Yes."

"Fine with me," I said.

"You'll swear?"

"Yes."

He nodded. "What do you hold most honorable?"

I paused for a moment. "I swear on the memory of my father that I will listen to your story with an open mind and I won't publish anything if it will do more harm than good."

He nodded. "OK. First of all, my name isn't William Harvey. It's Dr. Franklin Weiss."

"I figured William Harvey wasn't your real name."

"Let me continue, please." He paused for a moment to study my face, then went on.

"I was born—I was born in the year 2066." He paused again and gave me a significant look.

"Great," I said. "You're Klaatu."

"I'm who?"

"Klaatu. You know, from *The Day the Earth Stood Still.*"

He shook his head. "Sorry, never heard of it."

"You say you're from the future, and you've never heard of that movie?"

He shrugged.

"Fine. If you're really from the future, prove it."

"How?"

"Bring anything back with you? Like a fancy watch?"

He shook his head. "Too dangerous. Might contaminate the time line."

"OK, fine. Then tell me who wins this year's World Series."

He chuckled. "I don't know."

"Oh, come on! You'll have to do better than that."

"Do you know who won the World Series in the year you were born?"

"Sure. In 1930 Philadelphia took six games to beat St. Louis. It was the second time they won the World Series twice in a row. They also won in 1910 and 1911." I paused. "Of course, the Yankees won four in a row in the 1930s, and just finished a streak of five in a row a few years ago. So—"

He let out an exasperated sigh, interrupting me. "I don't even know who won the World Series last year. I mean, *my* last year. You know what I mean. This is ridiculous." He leaned forward. "Just listen. I am not making this up."

I nodded, and he continued.

"I went to Harvard Medical School and worked as a research scientist for twenty years. About four years ago, in 2116, what we thought was a virus began spreading in Brussels, Benelux, and across Europe."

"Benelux?"

He thought for a moment. "I think you'd call it Belgium."

I nodded. "Go on. You say this was a virus?"

"That's what we thought. One far worse than AIDS."

"Than what?"

He paled. "Never mind. We called the disease Tyler's Plague, after the research scientist at the International Center for Disease Control who identified it." He looked away for a moment, then looked back at me.

"Within four years," he said slowly and clearly, "it had killed two billion people." His voice was so sad, so serious. He seemed like a man describing how his wife or his child had died. I wasn't sure if this was because his family had been killed by the plague, or if he was just expressing the overwhelming feeling of a man charting the destruction of his species. I wasn't sure that I believed him, but I knew he wasn't making up this yarn just to protect himself. He actually seemed to believe it.

"Okay. So what was this plague? Was it a virus? Bacteria?"

He shook his head. "I cannot adequately explain how Tyler's plague

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changed the way that nations interacted. There was a level of international cooperation that had never before existed. The resources of the world were used in a joint effort to combat the disease. No one could identify how the disease was transmitted or how it was contracted. Test subjects in infection-free labs came down with it."

"I ask again: What was it?"

"Do you know anything about genetics and DNA?"

I glared at him. "I'm a reporter. I do follow the news."

He nodded. "Good, then you should know enough to understand my explanation. Still, I'll try to keep this simple. In around twenty years, a man named Leonard Hayflick is going to discover that human cells can only reproduce a certain number of times. Then they stop. But there's one kind of cell that doesn't stop reproducing."

He paused, and I made the connection. "Cancer cells."

"Exactly. Cancer cells can live forever. Did you ever hear of Henrietta Lacks?"

"No. Is she from the future as well?"

He sighed. "No, the past. *Your* past. She died in 1951 of cervical cancer. But her cancer cells lived on in cultures, well into the beginning of the next century. They seemed effectively immortal."

"That's hard to believe."

He shrugged. "I imagine that the rest of my story is even harder for you to believe. Anyway, you could look up the truth about the Henrietta Lacks cells today. Only to preserve her privacy, they're called HeLa cells. But to go on, it was the study of these cells that led to—to Tyler's Plague.

"Just two years ago, your time, Watson and Crick determined the double-helix structure of DNA. Well, in your future, it will be discovered that the DNA molecules are capped at their ends with what are called telomeres, which keep the DNA strands separate. But as cells reproduce, these telomeres get shorter, which is what leads to the Hayflick limit and cellular death."

"Except in cancer cells," I said, trying to figure out where this was going.

"Right. Cancer cells have an enzyme, called telomerase, which rebuilds the telomeres and keeps the cell from aging."

"So are you saying that in the future, everyone gets telomerase treatments and lives forever?"

He shook his head sadly. "No, that proved not to work. But we were able to tackle the problem from the other direction. There was a change made in all human DNA which inhibited the creation of telomerase. Do you understand?"

I thought for a moment, then shook my head. "No, I don't. Why would anyone alter all human DNA?"

"To eliminate cancer," he said softly, staring at his hands.

I whistled. "When did that happen?"

"In 2056. An oncologist discovered the exact part of human DNA which caused random cells to become cancerous."

"An oncologist?"

"Dr. Ralph Weiss. My father." Weiss scrunched his eyes and looked down at the floor.

"I'm sorry. I don't see the connection between curing cancer and causing a plague."

Weiss kept staring at the ground. "The telomerase didn't just keep cancer cells alive," he said. "It turned out that it kept *all* cells alive, for longer than they might have otherwise."

Now I understood. "Eliminating cancer lowered the Hayflick limit. Everyone started to die earlier."

He nodded, and I went on. "Your father cured cancer, and twenty years later, that meant the death of the human race."

Weiss looked back up at me; his eyes were wet with tears. "Not yet. Thank God, we're not too late."

"Even if this is all true, I'm still not sure what you're doing here."

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He looked back up at me. "At first, we tried to reengineer human DNA, to restore the cancer gene. But no one had kept the records, or any tumor cells. They were deemed too dangerous and destroyed along with the last remaining samples of the smallpox virus."

I nodded. "Biological warfare."

"Exactly. And so, we needed an example of cancerous DNA, and there was only one place to find it."

I made the connection. "In the past."

He nodded. "Yes. Time travel was frantically researched, and when it succeeded, we tried sending three people back. Two died in horrible fires and the third one disappeared. The three trips used up about 70 percent of the world's plutonium and uranium, so the President of North America ordered the time travel experiments stopped. Before the machine was dismantled, however, three other scientists and I gained access to it. I volunteered to go back as a last-ditch attempt to prevent the disaster we caused. The idea was for me to collect various kinds of cancerous cells, and store them for the future in the hopes of developing a cure."

He got up from his chair and opened the trunk, which was as full of gloves as it had been last night.

"The gloves which I put in the trunk contain trace cells from the skin of the various cancer patients I have touched. We do not need the actual cancerous cells, just any cell from a person with cancer. I plan to bury the trunk in a designated spot in New Mexico, where it will be recovered in the future. Then cancerous DNA will be restored and the human race will survive."

"What happens to you?"

He grimaced. "I burn the files and kill myself to ensure a minimal disruption in the time line."

I was shocked with the casual way he said that. "What about the people you cured? What about Hugh and Gordon?"

He laughed bitterly. "You idiot! I didn't cure anyone. We researched the medical records of various patients with cancer, and pulled the files on those who had gone into spontaneous remission later this year. I came up with the idea of pretending to be a faith healer, 'curing' the people who would have improved anyway.

"As for my associates, I hired them. Arnold was trying to go straight when he got out of prison, because he's got leukemia and recently found religion. And Elliot has a brain tumor. They're both going to be dead within a few months, so my having hired them won't hurt the time line much." He paused. "If you publish this, untold damage will be done. The human race will be wiped out."

I stayed three more days, sat through three more of his evening meetings. Weiss showed me the files on everyone he called up to the stage. He also let me look through the files of all the people he had seen in his previous shows, the people that Patty had told me had all gone into remission.

At one point, I asked him why he had bothered with the whole song and dance. After all, he could have just gotten cancer cells by stealing them from hospitals. His answer to this question convinced me that he believed he was telling the truth, even if I did not. He removed his glasses, wiped his brow, sighed, and stared out into space before finally replying.

"I get to give people hope," he said.

When I returned to the offices, I told Patty that I wouldn't have the story finished for a few weeks, that I still had some loose ends to tie up. Finally, I heard the news from Hugh that the Reverend Harvey had vanished, taking everything with him. I knew then that Dr. Weiss had killed himself and buried the trunk in New Mexico.

That afternoon I finished my article, an exposé of a fraud, a faith healer who was so distraught with guilt that in the end, he chose to take his own life. And

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then I went on to my next assignment, and did my best to forget.

But now, almost thirty years later, I feel compelled to commit all this to paper. My cancer has given me the reason; I can still remember the first time I heard the name Leonard Hayflick on the news, and my impending death has pushed me to write the true story down, despite the risks. But, John—if you find these papers because I failed to destroy them, and you've read all the way to the end, please heed my warnings. Don't let anyone else read them, or the future may not be saved.

I know you may find all this difficult, or even impossible, to believe, as I did back in 1955. You may want to show this story to doctors or other experts, to verify that it's not just the hallucination of your dying father. But if you do, you may destroy everything that Weiss gave his life for. As much as it pains me to say it, I ask you to keep the one thing I myself rejected all these years.

Have faith.

Asteroids and Lotteries

(Continued from page 6)

of early retirement than in a few minutes of chewing pleasure. And it's arguably far *more* sensible than a pack of cigarettes, which is not only unlikely to enhance longevity or quality of life, but highly likely to *reduce* longevity. (I say "arguably" because I, unlike some zealots, am perfectly willing to grant that people do have different priorities. If someone is aware of the risks of smoking and considers its pleasures worth sacrificing a few years of life expectancy, who am I to say he should live his life according to my preferences rather than his own?)

Similarly, a society which is well enough off to spend some of its resources on basic research can afford to spend a small fraction of that money determining systematically just how great the danger of asteroid impact is. It's probably unrealistic, and unwise, to expect more than that; but since that once-in-a-megayear event *could* happen quite soon, according to our present knowledge, it seems fairly ordinary prudence to at least improve that knowledge to the point where we can say much more positively what kind of danger, if any, exists in the fairly near future.

Chances are good that we'd find that there was no urgency and we could relax for a while (though it would be prudent to repeat the "check-up" at least every few decades). There's a slight chance that we'd find a threat so imminent we could do nothing about it, which would be disappointing in the first degree. But in between those extremes lies the possibility that we might positively identify a big danger, clearly requiring defensive action but allowing enough time to build an effective system solely for that purpose, to be disarmed after use.

And while asteroids and lotteries are similar in that they both involve events with very low probabilities but very large consequences, there are at least a couple of important differences between them. One is that winning a lottery is purely a luxury, not a need; but most of us consider survival a basic need, and that need is disproportionately greater when not just a handful of individuals, but an entire country, species, or ecosystem's survival is threatened. Another difference is that the asteroid impact is unlikely only on a per-time basis. That is, the probability of death by asteroid, per individual, per unit time, is very small; but its eventual occurrence, on any scale up to planetwide mass extinctions, is virtually certain.

The only question is when.

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Don't leave home without one. . . .

THE MONEY TREE

Charles L. Harness

His lips compressed into a thin smile as he studied the scene through the nightscope. Oh, they were clever, these counterfeiters with their near-perfect twenty. And their near-perfect cover. He read the sign. *John Witcher Nursery—Flowers, Trees, Shrubs.* The equipment was almost certainly in the greenhouse.

The light came on suddenly in the greenhouse. Sheriff Biggs looked away for a moment as his scope adjusted. Two figures—men—were entering the glassed building. He recognized Witcher. But who was the other? He got the new man in good focus, punched his camera cable, took a couple of shots. An overhead satellite forwarded the images to Washington. If you have a driver's license, buddy, we gotcha!

The report was back in seconds: *Quentin Thomas, lawyer. b 1980. BS Chem UVa 2004, JD UMd 2007. MD, DC, Patent Bars. Single. No arrests.*

A lawyer? thought Sheriff Biggs. Strange. Part of the gang?

The two men seemed to be deep in conversation. The sheriff strained at his earphones. He had a two-barrel voice amplifier (ACME Mail-order, $149.95), and it worked pretty well under certain conditions. But the greenhouse was just too far away. He was picking up voices, but they were garbled and full of static. He needed a better model, but a really good unit could easily run a thousand dollars. Double that for the Fed's famous five-barrel Ear, which could penetrate cinder blocks. He sighed and removed his earphones. Just not in the current budget.

Well, that was about to change. He'd crack this counterfeiting ring without benefit of the Feds. He'd get all the credit. He'd be famous. He'd get re-elected. He'd get two more deputies, two more patrol cars, two voice amplifiers—the best on the market. He would carry two cell phones. He wanted to be able to answer one, then say, "Can you hold? I have a call on my other phone."

He debated. Should he move in now,

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grab them both? On the other hand, maybe he should wait for backup. Deputy Bobby Wilson would be back from vacation Monday. Okay, let it ride.

Half a mile away another nightscope focused briefly on Sheriff Biggs. "Senator," reported the observer, "he just now ran an ID on Thomas."

The receiver said, "Looks like a routine investigation so far. Eventually we may have to bring Thomas into the loop, but I'd like to delay that for a couple of days, if possible. But keep an eye on the locals. If the sheriff shows signs of moving in, let me know immediately."

"Yes, sir. I don't think he'll do anything tonight. In fact, he's folding his scope and packing his voice amp. I think he's leaving. Ah . . . Witcher and Thomas are talking."

"See what you can pick up."

"We can talk out here," Witcher said. "We've got the PC here, and also I like to check up on the greenhouse from time to time. We had a burglary a couple of days ago."

"Oh? Something valuable?"

"Only to me. An experimental shrub. I was trying out my new process on a mutant *Salsola.* This could be troublesome. We just have to wait and see. Meanwhile, I saved all the seeds."

John Witcher, Ph.D., (Thesis: Evolutionary Aspects of Angiosperm Emergence), had inherited a little money from an indulgent aunt, which was fortunate, because his nursery was a loser. He was too often out of the very plants that his fewer and fewer customers came to buy. The County Nurserymens Association accused him of spending all his time on "that crazy stuff." There were rumors of odd goings-on in his greenhouse.

He told Thomas, "Well, let's get down to business. We start with the whole genome, in this case four chromosomes."

"You have mapped the whole genome? Quite an achievement." Quentin Thomas was regarded by his fellow professionals as a budding polymath who had never quite flowered, a potential scientist who had been seduced by the law; or worse, a lawyer who had yielded to the siren calls of test tube and microscope. His only defense: by whatever name, he loved what he did.

"Achievement?" said Witcher. "Well, yes and no. Nowadays, with the hole-membrane technology, anyone can run off a complete genome in a few hours. That's the easy part. The hard part is discovering what the particular genes *do,* particularly those that determine the appearance of the leaf. These are the genes for the meristems, which flank the main vein in the forming leaf and determine shape and dimensions. Also, I had to locate the genes that are specific to colors—red, green, yellow, brown, black. It took me ten years to work all that out for this particular plant, and then another couple of years to program it as a working vocabulary into a mainframe."

"Vocabulary . . . ?"

"Not letters or words, of course. More like Chinese ideographs, except several times more comprehensive than a Chinese dictionary. I use it with two main systems. Here, let me show you system number one. Together, we'll design a greeting card. Help me here. What size?"

"Uh . . . oh . . . four by six, I guess."

Witcher tapped at the keyboard. A white blank showed on the monitor screen. "And now, an appropriate legend . . . ?"

"Well . . . 'Happy Birthday' . . . ?"

A few more taps.

"My niece can do that on her PC," Thomas observed noncommittally.

"Indeed. And does her PC synthesize a heritable DNA sequence for automatic insertion in a plant cell?"

"Well . . . no."

"Listen."

There was a faint "pop"—apparently from an assembly of instruments and glassware lining a side wall.

"Gene gun," said Witcher. "One of the standard techniques for inserting

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foreign DNA into a cell. DNA attached to submicroscopic gold pellets is shot into the cells—in this case a selected group of freshly fertilized zygotes. Gene insertion has to be done immediately after fertilization, because the principal tissue systems within the embryonic seed will form within a couple of days, and after that heritable gene alterations are no longer possible. This way at least some complete sets of the foreign DNA penetrate at least some of the cells, and we will get at least a few altered cells, nicely formed chimera-seeds. We plant them. Some grow, some don't. The best will put out four-by-six inch green leaves with a legend in black letters, 'Happy Birthday,' and after these leaves drop in the fall, the plants will make hundreds of seeds—maybe thousands—and each seed can make another crop of greeting cards. Here—" He handed the lawyer what appeared to be a red greeting card.

Thomas accepted it gingerly. "'Happy Valentine' . . . ?"

"Yeah, third generation, still breeding true. It's a precise copy of a card I bought in a drugstore four years ago. I made it using system number two."

"Which is?"

"Nothing could be simpler. Once the computer is set up with the DNA translator it's just a matter of running the card through the scanner. Each pixel in the scanner will call up a corresponding nucleotide and insert it into the DNA chain at the proper locus. It takes just a few seconds, including the 'pop.' And it has a couple of additional features. Hold it slantwise to the light, like so."

Thomas did. "Well, I'll be dinged. The ink changes? Blue to black?"

"Yeah. Now, hold it up to the light, look through it."

"Fascinating. A face, buried in the leaf?"

"Shadowy, but there it is. Now you see it, now you don't."

"Anybody I know?"

"It's me, from a photograph."

"Remarkable."

"My thought exactly. And despite the new appearance, as long as the leaf is attached to the plant it continues to function as a working leaf. It burns energy, it respires, it photosynthesizes, it converts carbon dioxide to carbohydrates, all the usual stuff. Patentable?"

"Quite possibly. Certain aspects, anyway. This was once a leaf on a shrub?"

"Yeah."

"Can the shrub be grown from a cutting?"

"No, only from seed."

"So you don't have asexual reproduction. You can't patent the seed or the plant, but you can get good protection for seed through the Plant Variety Protection Office, in Beltsville. You'll have to deposit a couple of thousand seeds, fill out some papers, and so on. We'll go into that later. Right now, I'd suggest that we file applications in the Patent Office covering your two basic systems for inserting DNA sequences into seed embryos. Give me the data, I'll prepare the specifications over the weekend, be back here for your approval and signature Monday, and we'll fax them into the Patent Office."

"Sounds good."

It was Monday noon. The lawyer and his client were sitting on crates in the greenhouse having coffee and oatmeal cookies. It had been a busy weekend for Thomas. Nearly thirty billable hours. But the two cases were typed, signed, and now faxed into Crystal Plaza. The Patent Examiner would take them up in turn, and if everything worked, eventually two very valuable patents would issue. Meanwhile he could relax.

An overhead bell rang.

"Front door," said Witcher. He picked up the phone. "Who is it?"

"Sheriff Biggs, Dr. Witcher. Wonder if we could talk?"

"Sure. I'm back in the greenhouse. Can you come around?"

Thomas looked askance at the inventor.

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Witcher shrugged. "I haven't the foggiest." He walked over to the glass door and let the two officers in, first the sheriff and then the deputy. "Well, Sheriff, what's up?"

In heavy silence the sheriff pulled a glassine envelope from his shirt pocket and from the envelope took what appeared to be a twenty-dollar bill. "Recognize it, Doctor?"

Witcher reached out. "May I?"

Biggs hesitated, then handed the artifact over to the botanist, who held it up to the light. "Gracious! From the stolen shrub!"

Thomas got the picture instantly. The burglary: an experimental bush. That grew twenty-dollar bills. His heart fluttered. This could be serious. He took a step forward. "Sheriff, I'm Quentin Thomas, Dr. Witcher's attorney. On advice of counsel, my client declines to answer any further questions."

The officer looked at Thomas dubiously. In silence he retrieved the greenback.

The lawyer said, "Be that as it may, and without admitting anything, perhaps we can explore certain hypothetical possibilities. For example, perhaps a local citizen has reported to you that this bill was picked from a bush. Am I close?"

The officer's eyes hardened. "Go on."

"And perhaps the citizen claims that the bush was very recently stolen by person or persons unknown, juveniles, perhaps—from Dr. Witcher's greenhouse, and that examination showed it to be loaded with bills? Something like that?"

The sheriff was silent.

"You didn't believe him, of course. Probably just a kid? We're still hypothetical. But you weren't fooled. Money doesn't grow on trees or bushes or whatever. Money has to be *printed*—using metal plates, or stones, or copy machines."

Biggs studied the lawyer for a moment. "Mr. Thomas, this bill isn't hypothetical." He handed it to the lawyer. "There are two standard tests. Hold it at a slant to the light. You'll note that the '20' in the lower right hand corner turns black, then back to green as you shift the angle. Hold it up to the light. You can see the shadow face of Andrew Jackson. No counterfeit is supposed to pass these tests, but this one does, and all the evidence points right straight to Dr. Witcher."

"I take your point, Sheriff. On the other hand, we fail to see that my client has broken any law. Can you name one?"

"Thomas, you playing games with me?"

"Certainly not, Sheriff. But let's look at the statutes. I'm sure you're familiar with 18 USC 471."

"Sure, fifteen years for making counterfeit bills, and each bill is a separate count, and sentences can be cumulative."

"But there has to be an intent to defraud."

"Which we could leave up to the jury."

"And 472?"

Biggs shrugged. "Fifteen years for passing." He removed a pair of handcuffs from his belt and tapped them on a flower pot. "What is this, the counterfeiting catechism?"

"Sheriff, my point is, the hypothetical bills were the product of a botanical experiment and were made without fraudulent intent. They were not 'passed'—they were stolen. You'll never get a conviction. Surely you can see that."

Biggs said, "Dr. Witcher, you are under arrest." He got a card from his pocket and read off the Miranda in a monotone. "I hope we can do this peaceful-like. Put your hands behind you. "

Just then the side door opened and a man entered.

Everyone looked around, and stared.

The entrant, a well-dressed white-haired man, carried a thin briefcase in his left hand. He seemed to take in the situation at once. He smiled. "Sheriff, do you know me?"

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The officer managed a strangled stammer. "Senator . . . Senator Black?"

"Exactly. And perhaps you would be good enough to remove the manacles from Dr. Witcher?"

"But Senator, I've got him on several counts of counterfeiting, and maybe worse. He's trying to tell me he makes money grow on trees."

"Trees? I think he means shrubs. Anyhow, the cuffs?"

"But . . . I . . . he . . ." Sheriff Biggs had a sudden sense of walking on the ocean bottom, with tons of water over his head. If he inhaled, he would drown. But he was a professional, and even in his bewilderment he recognized preemptive authority. He removed the handcuffs.

The new visitor addressed the lawyer. "You're Quentin Thomas?" They shook hands.

"A great pleasure, Senator. And may I speculate that you are here in your capacity as chairman of your committee?"

"Very perceptive, sir."

Witcher rubbed his wrists gingerly. "Committee? Senator, what's going on?"

"Me too," Sheriff Biggs said plaintively.

"I'm Chairman of the Congressional Anti-terrorism Committee," the senator said bluntly. "And before we go further, I must tell you that matters to be discussed here are covered under the Secrecy Act. Disclosure to unauthorized personnel is a felony and is punishable by fine and imprisonment." He turned to the young deputy and read the named sewn into his shirt pocket. "Deputy Wilson, under these circumstances, perhaps you would prefer to be excused?"

Bobby Wilson would very definitely *not* prefer, but he exchanged glances with his superior, and he left.

The Chairman laid his briefcase on a nearby table and pulled a document from it. "Now . . . this for you, Mr. Thomas. I believe you faxed two applications into the Patent Office this morning. Will you please give me the two titles?"

The lawyer hesitated.

"Come now, Mr. Thomas. I could get them from the Patent Office. This is quicker, and we have much to discuss."

Thomas sighed. "All right." He read off the titles and watched the senator fill in some blanks in the document, which he then handed to the nurseryman.

"What's all this?" demanded Witcher.

"He's putting the cases under Secrecy Order," the lawyer said grimly.

"Which means?"

"They may never go to patent during your lifetime. Some of the early atom cases are still sitting under Secrecy Orders."

The senator broke in. "Oh, it's not all *that* bad. And actually, Doctor, it could be worse, a lot worse: under the law the government could seize your patents, and if you didn't like our offer of compensation, you would have to take us to court. Now, I suggest that we all relax, and let me explain the whole situation."

"Of course, Senator," said Thomas.

"There's this Mideastern country. We'll call it Quran. It's got oil and a very unstable government, which is presently controlled by a radical group, Bukra—which means 'Tomorrow.' Bukra has a secret agenda. Phase One requires two years and heavy arms buildup: nukes, tanks, artillery, biologicals, the largest conscript army in the Mideast. They will buy a lot of this with oil money, taxes, and international loans. But that won't be enough. So they will seize all foreign holdings and auction them out to the highest bidder, who in many cases might well be the original owner. Finally, Westerners are to be arrested and held for ransom. In the worst scenario we can expect nuclear war in the Mideast." He looked around. "Some place we can sit down?"

Witcher pointed to benches near the opposite wall. They walked over.

"The CIA is working on a couple of non-military remedies and will assist in this one," continued the senator. "We want to delay military action—theirs and/or ours—as long as possible. Our

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project . . . *this* project . . . is intended to help string out that delay, and to do it without bombs or bloodshed."

Sheriff Biggs frowned. "How?"

"With funny money," Thomas said. "The Keynes theory. The best way to destroy a society is to debauch the currency."

"Precisely, Mr. Thomas," said the senator. "With Dr. Witcher's kind assistance we propose to destabilize currency in Quran."

Witcher chuckled. "I get it. *Very* clever, Senator."

Sheriff Biggs sighed. "Maybe somebody could tell *me?*"

"We will scatter money-shrub seeds in the fields of Quran," the senator said. "The seeds sprout into shrubs, the shrubs leaf out with twenties, go to seed, then more shrubs, more twenties. Suddenly you have inflation. Bad at first, then worse, then fantastic. A million dollars for a loaf of bread. Then all paper money becomes worthless. The financial structure collapses. The country is forced to return to an economy of coins and barter. No money for weapons. How did it happen? Where did the shrubs come from? The CIA will disseminate facts tending to show that Bukra is responsible."

"As the shrub," Witcher said, "I would recommend a variety of *Sisymbrium altissimum,* specially mutated to allow for larger leaf size. A fine tumbleweed, two to four feet high. When dry it breaks away from the ground and rolls wherever the winds take it, scattering seeds along the way. Two cycles a year under proper conditions."

"Your call, Doctor," the senator said gravely. "And I should mention, I am authorized to offer you a consulting contract: five million a year for five years, our option to renew for another five."

"That's fair. Mr. Thomas can draw up the contract?"

The lawyer laughed shortly. "Unless the senator just happens to have a set in his briefcase."

The Chairman chuckled. "You are one smart lawyer, Mr. Thomas. It just so happens, I *do* have a set." He handed the documents to Witcher, who passed them on to Thomas. "You'll note, gentlemen, all copies have already been executed by the government."

The lawyer checked the last page, and his eyes widened. "The . . . *President?*"

Senator Black smiled. "So I hope you won't suggest any changes? He's a hard man to get back to. And we'd like to fly the first batch of seed over tonight. My ballpoint, Dr. Witcher."

The scientist signed.

Senator Black stuffed his copies into his briefcase. "Now, Mr. Thomas, I'm curious. I'm wondering if you'd care to predict what we'll need next from the good doctor?"

"A wild guess. You want him to grow cultivars for more bills. Probably starting with ones, fives, maybe on up to hundreds. And not only U.S. bills, but also equivalents for Quran currencies. And I suspect you've brought him a package of fresh notes, right off the presses."

"Close, sir. Very close indeed." He took a brown envelope from his briefcase and handed it to Witcher. "True, here are the exemplars, starting with ones, for both the U.S. and Quran. However, we go a bit higher than the hundred dollar bill." He opened the envelope. "My friends in Washington say I need a receipt. Another signature, I'm afraid, Doctor. And better check them. Yeah, that thousand-dollar Federal Reserve note should play hell in Akkad." He held out a pen and a slip of paper.

"If I could make a suggestion," Thomas said mildly.

"Of course."

"Put up a twenty-four-hour guard around this place."

"We have already done that," said the senator. He looked around. "I think we're through here, for the time being."

"Senator," said the scientist, "before you leave, what alerted you to my little experiment?"

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"The Forgery Section of the Secret Service found one of your bills. And then your bush, which they still have." He smiled. "And off the record, Doctor, why did you create the thing in the first place?"

"Just plain stupid curiosity, Senator. It was the acid test. If my process could work on a very intricate U.S. banknote, it could work on anything."

Sheriff Biggs frowned. "Senator, fellows . . . with all respect, won't these bills work their way back here to the U.S.? Hurt our economy too?"

The Chairman nodded. "Some may, Sheriff, but not many. At least not as counterfeits. Right, Dr. Witcher?"

"Quite right. You see, Sheriff, these may be beautiful counterfeits, but they are still *leaves*. They will indeed look good for a few months, but they must inevitably dry up, turn brown, wither away."

"Leaves. Yeah. Okay." Biggs shrugged. But it just wasn't ending right. Well, local law still stood for something. He'd give them something to ponder. He put a cigar in his mouth, retrieved a twenty dollar bill from somewhere, lit it with a lighter, then used the burning currency to light his cigar. "Always wanted to do that." The bill dropped to the floor. He stomped on the ash, bowed, then, head high, he walked out the door.

Dr. Witcher shook his head. "He shouldn't be smoking."

"I think that was a real twenty," the senator murmured.

"Hum . . . ?" said Thomas. He sniffed. Like leaves, burning in the fall?■

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A Pig Tale

Guy Stewart

What constitutes kindness is not always clear-cut. . . .

Damp, cool air carried the words clearly.

Rachel Sheffield said, "We're splitting, Dad. I know you don't like it, but . . ." The words seemed to hang between them as they tramped along the back road. Their heavy boots plowed through ankle-deep layers of tawny oak, golden poplar, scarlet maple, and yellow elm leaves.

"Tried working things out with . . . um . . . Ray?" her dad asked. The plaid ears of his blaze orange hunting cap were tied up, showing wisps of the salt-and-pepper hair tousled beneath it. His tan hunting jacket was stained, torn, mended, and worn thin by the years. Yet it covered his long, rounded frame as it had when they'd hunted squirrel, deer, and pheasant when she was a teenager.

She didn't say anything for a long time. Her hand went to the braid at the back of her head. She played with it for a moment, thinking that it was like the pigtails she'd worn as a child. Had she really tried to work things out with Ray? After he found out about her and her boss, Glenn Furman, he'd barely said a word. He'd spent every free moment he'd had with the Jessica and Scott. He was civil when the kids were around, but he'd started coming to bed long after she was asleep. He was gone when she got up. She'd factored the equation pretty quickly and kept out of his way.

Then he'd moved out with the kids and she'd gotten the separation papers.

That was Thursday. She'd walked into Furman's office and told him she'd be taking a leave of absence. He'd been furious. They were in the midst of clinical trials of a broad-spectrum memory reconstruction virus that she'd been instrumental in developing. The test results looked nothing short of miraculous. There was a medical ethics battle brewing regarding the use of the virus on Alzheimer's patients.

Fanatics were not limited this time to the Religious Right. The Liberal Left was

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weighing in with some hefty legal fist shaking, too. Things were about to blow.

But she didn't care. Didn't care about Ray. Didn't care about the kids. Didn't care about her job. Didn't care about Furman any more, either. He'd been a diversion. Nothing more. An attempt to stave off a haunting feeling of worthlessness. She'd walked out of the lab, gotten into her car and driven from Chicago to Kenyon, Minnesota, in seven hours.

She'd caught the scent long before she reached the hog farm. Most people hated it. So did Ray, but he'd learned to suffer in silence. But to Rachel it evoked only one memory: safe haven.

The back door had been unlocked when she pulled into the barnyard late at night. Ruthie remembered her and the car and didn't bark. She'd crashed in the Twins' old room and waked to the smell of coffee, fried eggs, bacon, sausage links, and peanut butter toast. She'd also waked to the sound of squealing pigs in the out buildings.

"I think I did, Dad," she replied.

He stopped and turned to her, his shotgun angled down, draped casually over one arm. He fixed her with a long gaze.

She returned it at first, then her vision blurred and she looked away.

Her dad grunted, then started walking again. She wiped the pair of tears from her face and shuffled after him, fiddled with the pigtail again.

They moved up a hill, then stopped on the crest that overlooked the back forty. A narrow stream—only full of water after a hard rain—wound its way through the fields. The back road dipped down into the small valley it had created. Beyond, crowning a hill in the distance, was a grove of cherry trees.

She stopped beside him, looking out over the fields. The last harvest had been taken in, and the cornfields left stubbly for winter. Alternating with the stubbled fields were fields of alfalfa, still faintly green even though it was November. "When you weren't tellin' the truth, Rachel, you always had a guilt glint in your eyes. Like the time you took the car into town and went to that college-boy party."

Rachel hung her head. He'd known all these years. Yet the next day she'd lied bald-faced to him that they'd had an all-girl slumber party at Shelly's. He took her at her word and never even implied that he knew he'd been lied to.

"I seen the guilt glint then, and I seen it a second ago." He turned to face her. "You really try everything?"

This time she lifted her head to look him straight in the eye and said, "I haven't tried at all, Dad." She let her eyes wander back to the cherry grove. "The fact is that I don't know what I want. I thought I'd be happy. I got the job I'd always dreamed of, respect in my field, a husband I once loved, and a pair of wonderful kids. I thought this would be it." She blew softly, a cloud of white condensing before her. "But it's not."

Her dad did the same thing. Exactly. He said, "Happy. Funny word that. Happy seems to come and go. Peaceful seems a more important thing to look for in life."

Stung, she snapped, "You don't know what I've been through lately."

He looked at her, nodded and said, "You don't know what I been through lately, either."

She scowled, curious despite the sting. Curiosity won. Always had. She asked, "What?"

He started walking again. Stopped for a moment at the stream, looked both ways, then stepped gingerly over it and went up the other side. She followed. He stopped again and turned to look back. Rachel did, too.

They couldn't see the house from here, but the vent boxes on the tops of the barns seemed to float over seven acres of oak forest behind the house. Farm sounds drifted back to them: someone running a tractor, the conveyor belt up to the barn loft rattling and

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squeaking away, hog noises. The safe smell of pig manure drifted on the chill autumn wind.

"Gonna lose the farm."

"What?" Rachel exhaled.

"The farm. Repossessed. Can't sell enough pork at a good enough price to keep up on the bills. PorkCo down the road's offered to buy me out. After this winter, I'll sell out the hogs, and your mom and I'll move into town."

"But, Dad, why?" Her voice pitched high—the way she'd sounded at her wheedling best in eighth grade.

"Your Mom's not getting any younger. Me neither. Little farms can't produce at the big corp's level. We can't sell our pork that cheap and still pay the bills. So now we can't sell our pork at all—and the bank's after all us small-timers."

"Can't you do something about it? Organize? Unionize? Something?"

Her dad smiled. "It's been coming a long time, Baby Doll." He shook his head sadly. "We expected it. We're gettin' on. I forget things sometimes. Things I should remember. Your mom and I figured we'd retire on our own. As it is, they're forcing us out."

"But how, Dad?"

He made a motion with his head to the east. "You ever seen PorkCo's operation? They have a hundred and twenty-eight barns. Four hundred hogs in each barn. You're the doctor, you do the math. The larger the population, the more economical it is to deal with. PorkCo can feed, water, and heat more hogs than I can. But I still need to feed, water, and heat 'em. Same equipment, same supplier, same cost—and less than half the profit when all's said and done. The meat plant don't want to deal with us small-timers anymore, either. So we don't have anywhere to sell locally. . . ." He spun away and stomped off in disgust.

Rachel stood looking at the barn vents. She turned and followed Dad. By the time she caught up with him, he was nearly to the cherry grove. When she pulled alongside of him, he said, "Besides, none of you kids want the farm, really." He looked up suddenly. The hope in his eyes made her wince. "Do you?"

Rachel stopped, this time at the edge of the cherry grove.

Memories rode from a mothballed past, things she hadn't remembered for years. Adventures with her three brothers and her sister in the grove, the barns, the oak forest. Tree houses, treasure hunts, hide-and-seek, rope swings, and wild runs through moonlit forests. Hansi hit by a car, litters of kittens, piglets, a visceral understanding of *Charlotte's Web,* and a crush on a handsome new veterinarian when she was fourteen.

So much of her had remained here. The best parts of her. Then she shook her head and said, "I'm not a hog farmer, Dad. And I can't imagine Jessica and Scotty wanting to move out here. . . ." Then she remembered that, as of yesterday, she was legally separated. "It would never work. I've got my job and now I don't have much of a family left—except for the one I started with."

Dad grunted, then put his big, heavy arm around her shoulder. They stood that way for a while, watching as a pair of crows flapped heavily into the air.

"Gonna shoot 'em?" Rachel asked after a moment.

"Naw. Don't shoot much of anything anymore. Gettin' old, I guess. Don't have much fight left in me." After another moment, he dropped his arm and turned back toward the main buildings. "Should be getting back."

She nodded as they set off together.

They were at the foot of the hill again when he asked, "Staying long?"

Rachel shrugged as they stepped across the dry streambed. She stopped, studying the hard, dry rivulets. Stones lay exposed by the water that had run along here days, weeks, or months ago. She looked up at Dad. "I don't know. I took a leave of absence when Ray had the papers served to me."

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He nodded, then looked off into the distance. She looked down at her feet again. With a long sigh she set off. Dad walked alongside her. Gray clouds overhead made for a silvery, featureless ceiling, promising neither rain nor fair weather.

When they got into the house, it was time for the evening chores. The silvery sky had taken on a deeper, softer shade of charcoal.

Mom was standing by the stove, peeling potatoes and dropping them into a pot of boiling water after deftly slicing them into quarters. She looked at the two of them, then smiled, deep lines crinkling at the corners of her eyes. "Just like when you were a kid," she said softly. "I suppose you'll be going out to help Dad with chores?"

Rachel looked at Dad, then at Mom, shook her head. "I think I'll stay in here, if you don't mind. I brought some journals I want to look at—never any time at work." Both of them nodded, and Dad went out into the mudroom to pull on his work clothes. Mom went on making dinner as Rachel headed for the family room.

The glass doors of the fireplace were closed and there was a chill in the room. Rachel called, "Mind if I build a fire, Mom?"

Her mother came to the door, wiping her hands on a blue gingham dish towel, a delighted smile on her face. "That would be wonderful! We haven't had a fire in there since—oh, I don't even remember. But the things are all there, dear. Go right ahead. Dinner will be in about an hour and a half. After Dad gets done with chores and cleaned up."

Rachel nodded and knelt by the fireplace and busied herself. Dozens of memories began to tumble again as the stream of a happy past thawed. Christmases, Easters, Thanksgivings (she'd missed the last two), baptisms, funerals, confirmations, and weddings past bounced by her, each one glittering like wet corundum.

On her fourth try, a flame flickered and ate away at the dry tinder. She fed it until it was a snapping fire, almost forgetting to check that the damper was open. She rested back on her heels and closed the glass doors part-way. An old, orange plaid chair sat nearby. She climbed into it and curled her feet up, watching the flames eat away at the wood. Orange and white and blue. She smiled a little for the first time in weeks, the heat of the fire warming her knees and hands, adding a smoky, piney odor to air already smelling of roast pork.

She was watching the fire, smiling faintly, the stack of three journals resting near the fireplace when the kitchen door was thrown open.

"Pat! Pat! It's Chuck!"

Rachel was on her feet and in the kitchen before the stranger had turned and run from the house.

Mom threw her a terrified look.

"I'll go," Rachel said. She shoved her feet into the boots still sitting by the door and ran out into the cold night air. It was dark. The yard light was on and the few windows in the big, main barn glowed yellow.

Her mother was right behind her.

The stranger—a hired hand, Rachel thought—was standing at the open barn door. "Hurry," he shouted.

They pushed past him. Dad lay on the floor, pale, eyes closed.

"Heart attack?" Rachel asked as she knelt beside him.

"We called 911. He must have just done it when we found him. He was kicking and swinging something terrible."

Rachel looked up at the man, "What do mean he was 'kicking and swinging?'"

The man glanced at Mom, his eyes round. Mom huddled closer to Rachel, grabbing the material of the flannel work shirt she'd worn all day.

Horrible realization swept like spring runoff over Rachel. "You're telling me he tried to hang himself?"

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The man looked directly at Rachel, eyes pleading. He nodded.

Mom gave a faint, moaning sigh and sank to the floor. The hired hand caught her as a wailing siren Dopplered into the barnyard. The first hired hand motioned to another, younger, blond man who ran out of the barn. In moments, there was no way to talk as the room was filled with paramedics.

Seven hours later, Rachel sat beside Dad. He was awake, staring up at the ceiling from his hospital bed. Eyes blinking slowly. Rhythmically.

The bed was new. It monitored his vital signs without cuffs or pads or wires. All information was displayed on a screen facing the door of the room, as well as at the floor monitor station.

Mom was propped in an easy chair, the footrest up, her head lolling to one side, mouth slightly open, eyes closed, sleeping. Rachel had asked for a sedative for her about an hour ago. Rachel wanted to talk. To Dad.

"When were you and Mom going to have to leave the farm?"

He didn't move for a long time. Finally he licked his lips and whispered, "Monday."

Rachel hung her head. "I thought you meant that you'd finish out the season, sell off the spring farrow and close down after that."

He moved his head slightly side-to-side, winced. "First of December," he whispered. There was an angry red rope burn around his neck.

She cursed silently, long, inwardly, deeply, viciously at . . . nothing. Dad had never approved of coarse language. He and Mom had been churchgoers all their lives. But once she left home for college, she'd never set foot in a church to worship again. It hadn't been her and Ray's style. They respected Mom and Dad's beliefs without sharing them. Bitter regret threatened to sweep her away in a wash of frigid memories. Instead she focused on Now.

To let loose with a string of invective would probably wake Mom and upset Dad. So Rachel mentally flayed the elected officials, the economy, the bank executives and the PorkCo magnates who had made Dad's last cry for help so harsh. She patted Dad's upper arm in the non-silence of the hospital room.

"Don't hate me," he whispered.

She stared at him, dumbfounded. "Hate you for what? Trying to escape an intolerable situation you're powerless to change? For trying to maintain a lifestyle you, and generations before you, created close to land you love?" Silently she added, For acting as keepers of one of the best parts of my life? "I don't hate you, Dad. I . . ." Unexpected pressure built behind her heart. Feelings penned carefully inside pressed against the walls of the pen like hogs downwind of the special hot corn mash she, and her parents, and brothers, and sister had doled out on Thanksgiving Day every year for as many years as she could remember.

They broke free.

Rachel wept.

It was a long time before she lifted her head. Mom was asleep. Dad's eyes were closed. For one horrible moment, she thought he'd died. Disoriented, she looked around frantically, her eyes finally coming to the monitor. Vital signs all normal. Breathing rhythmic and slow. Heart rate steady.

Three o'clock in the morning. She stood on weak legs. Pins and needles surged from hips to toes as circulation came back and crimped nerves straightened. Sleeping while leaning head-first against a hospital bed rail, lack of sleep the night before, rich food, and her father's attempted suicide gave her a sour mouth, queasy stomach, gritty, painful eyes, and a faint sense of temporal disorientation.

She tottered from the hospital room, leaning heavily on the door frame, then the wall as she stepped into the carefully neutral colors in the carpet and on the walls.

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Kenyon's hospital was joined to a nursing home and served the town as well as the county and a half-dozen surrounding communities. It was warm—homey in an odd way that country hospitals have. Nothing like their big-city counterparts. She wandered to the front desk, smiling blearily at the nurse working the monitor station. He smiled back and said, "Can I help you find anything?"

"No. I'm just here with my dad and mom," she said. Her normal professional tone had disappeared some time between her arrival and weeping. The nurse nodded and went back to work.

She made her way to the lobby. Overstuffed chairs arranged in psychologically sensitive small groups. The wallscreen television was off. A massive, transparent column of glass holding a marine aquarium grew in the center of the lobby. She went to a chair and dropped into it, facing the tank. Columns of tiny bubbles dribbled upward from the bottom. Brilliantly colored reef fish darted, swirled, hovered, and back-finned over achingly white sand and muted orange, red, cream, and yellow coral. Anemones and urchins fluttered and trundled as if blown by a slow motion wind.

She drifted off to sleep a moment later, dreams of dancing sea stars studded with silvery bacteriophage T4's—heads shaped like large connectable plastic baby toys, a collar, tail sheath, base plate and tail fibers—fluttering around her, puncturing sea stars and making them shrivel and turn to sparkling glitter as they broke up. Then she was sitting in the farrowing shed on a bale of hay, piglets nursing, the warm, moist air close and comfortable. She plucked a lemon-colored sea star from the air and tossed it to one of the sows. She swallowed it and then suddenly someone was clearing their throat right beside her. She jerked to a sitting position, swaying dizzily.

"Excuse me, ma'am?"

Rachel looked stupidly up at a young man, long hair held back in a plaited braid. "Hmmm?" she managed, her mouth and lips dry.

"Your mother is awake. She wants you to take her home."

Rachel nodded and pulled herself to her feet. The lobby's clock showed that it was a little after five A.M. Without really looking at him, she rasped, "Thanks. Thanks. I'll . . . uh . . . take her now." She made it back down the hallway to Dad's room. Mom was standing, staring at Dad when Rachel walked in.

"What's wrong, Mom?"

Her mom shook her head, then went to the window and pulled up the blinds. It was pitch dark outside. Winter solstice a little over a month away. "He likes to look out the window. Likes to be outside. Hates begin cooped up."

Rachel nodded, then went to her mom and gently took her arm. All the lights in the room but a softly golden lamp set above Dad's head were out. Its light made his face seem tan. Healthy. A shadow covered the noose burn. "Let's go, Mom."

They drove home through the steady darkness, stars shining so brightly they seemed to be holes poked through some heavy fabric, allowing light from a white-hot fire behind it to shine through. Cold, stubbly fields flicked past silently once they left the bright reddish lights of town behind. Rachel closed her eyes hard, then opened them, trying to squeeze out the grit. By the time they reached the farm, she was shaking with fatigue.

Mom stopped in the middle of the gravel turn around as they made their way from the garage to the house. "How are you, Rachel?"

She briefly debated lying, then thought better of it. "I came out here to get away, Mom. Ray and I have separated. He's got the kids right now. I left Chicago to . . ." abruptly she didn't know why she'd left the city behind. Not to bury herself—the City had far more to bury herself in than the little

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town of Kenyon. She stammered, "I . . . I don't know why I left. I don't know for sure why I came here. And now, all of this. . . ."

Her mother nodded, slipped her arm through Rachel's and started moving again. Together, they walked over frozen, crunching gravel. Hog song drifted from the nearby barns and the well pump came on suddenly, humming in the not-silent night. Overhead, the yardlight buzzed, busily exciting mercury vapor to emit photons.

"It's why you came back, Dear," Mom said.

"What? To see Dad try and kill himself? To spend half the night in a hospital?"

"No, to be here. Where you started."

"Where you're going to end, Mom. Where Dad almost did end!" she shouted. Anger surged up past her normally rigid defenses. At work, she ignored the feelings that didn't clearly move her closer to her goal. Her feelings for Glenn Furman had greased the wheels for special requests, made her projects magically rise to the top of the heap and kept her ahead of everyone else. The anger faded. "Sorry, Mom. It's been a long night. I don't know what I'm saying."

They reached the back steps, walked up and through the mud room, into the dark kitchen. Mom slid off her coat, draped it over the back of a chair. Rachel did the same. Mom said, "Want a cup of cocoa?"

Rachel hesitated, then shook her head. In the dark family room, she could see the faint red glow of coals in the fireplace. "I'm going to get the fire going again."

Mom nodded. "Good night, then, Rach," she pronounced it "Raych", like she had all of Rachel's life. "I'll see you in the morning."

"Night, Mom," she kissed her, then went into the family room, hearing Mom walk up the creaking steps, then across the ceiling. Quiet shuffling, then squeaks from the bed as Mom got in. By then, Rachel had the fire blazing. She settled back in the chair, the reading lamp on, a journal in her lap. This one had an article by her and the team at ViroMax. She flipped open to it, scanned it, smiled. Her work was good. Some were hailing her as the Louis Pasteur of viruses. She and her team—Furman included—had already developed a vaccine that totally arrested HIV-1 and HIV-2. She'd have had a Nobel last year if Jamal Harris at GeneTech in Atlanta hadn't KO'd the most common cold virus. Next year, though—Americans were aging and Alzheimer's was an increasingly disturbing problem. ViroMax and others had shown that Alzheimer's was a complex interaction between genetic factors, certain types of viral infections and memory-related neural steroids in the brain.

She scanned the other articles, mostly by people she knew personally. One article by Dr. Christine Hester touched on the genetic engineering of specific viruses for use in terraforming Venus. Furman had tried to hire Hester. She'd turned him down flat, laughing at his money.

Rachel started suddenly. When had she started calling him 'Furman?' His name was Glenn. She looked at the fire and closed the magazine. She stared at the flickering orange, white, and blue flames, momentarily frustrated by all that seemed to be happening. But only one thing was important now: Dad and Mom. Them. Together. At the farm she'd been brought to as a newborn; grown up on—she smiled briefly—longed to get away from; returned to.

It was going to be sold and her parents would move into town. And now with this suicide attempt, someone would suggest that they move into the 'retirement home,' and that would kill Dad just as surely as a noose around the neck. Yet what could she do?

She tapped the *Journal of Research Virology* in her lap. There were many things she could do. Engineer a virus—

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perhaps something insidious—and infect PorkCo's stock with it. Maybe something that needed lots and lots of pig breath to thrive. Then it would skip over family farms and only hurt the corporate farmers. She scowled and stood up. She put another log on the fire, stopping at the picture window that looked out over the empty fields to the place down the road. She couldn't see anything this early in the morning. But she knew the Duerkops were down there. Dave, Barb, Nathan, Caleb, Elise. Always had been. Always would be.

Not.

Maybe they were just like her father—a family farm being forced out by bigger and bigger corporate farms. Maybe they were packing boxes at this very moment, bone-tired from the preparations for the move. Bone-tired, but with nowhere to lay their heads because some massive conglomerate had to make a few more bucks and destroy a little bit more of the competition so they could have a little bit bigger piece of a rapidly shrinking pie. . . .

Rachel went back to the chair and, closing her eyes, leaned back for a moment, trying to order her chaotic thoughts. She couldn't change the world. She couldn't even manage her own. She couldn't save Dad and she couldn't save the farm.

She couldn't do anything right. . . .

She woke with a start and the family room was bright with sunlight streaming through the picture window.

The smell of coffee hung fresh in the cool air. The fire was dead. "Mom?"

There was no response. She went into the kitchen, wrapping an orange afghan around her shoulders as she walked. There was a small square of paper on the kitchen table. She smiled, remembering the uncounted number of notes left the same way all through her childhood. She read, "Went to Hospital. Nurse said Dad was Fine. Come if you want to. Mom"

Rachel poured herself a cup of coffee from the pot on the warmer. Two dirty cups sat in the sink, half-filled with water. One had a spoon in it. She picked it up, rinsed it, and spooned sugar into her own cup, stirring as she walked back to the recliner. She sat again, looking out the window.

Abruptly, a memory surfaced. Snowmobile rides with Rob Brace flashed back. She was fifteen and he was an older man. All of sixteen she recalled.

They'd been racing another boy and his girlfriend across the field. The other boy had lost control of his sled. His girlfriend had been thrown clear, but he'd broken his neck. She and Rob had flipped their sled while turning back, but they escaped with nothing but bruises. After the look of stark terror in her parents' faces when they'd heard the story, she'd been banned from dating Rob for the rest of her natural life and grounded for the rest of the school year. It had taken Mom and Dad years to actually forgive him. She doubted if they'd ever forgotten the incident. She hadn't.

She caught her breath. The idea appeared complete, slamming her in the face like the hard, icy furrows had that day riding with Rob. Elegant. Stunningly complete. Simple, in fact, though experimental after a fashion and certainly not the use toward which the research had been intended. But Furman would never know, and she could easily alter a record here and a few words there to cover any tiny tracks she made.

She stood up and went to the phone after looking up the number for the nearest airport. Once she was finished, she scribbled Mom a note and drove ninety minutes to Rochester. The flight in the twin-engine Baron to Chicago took just over an hour and a half. She slept hard even so. In a taxi, she was at ViroMax an hour later. Her clearance got her through security with no problem, even though it was Saturday. In fact, she knew the weekend staff almost as well as she knew the regular crew. They

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knew her, too. Well enough that the college guy on duty at the check-in desk flirted with her—again.

But she wasn't interested in teasing him. She hurried to her own lab and logged on. After a few moments, she started manipulating the images on the screen. Clearly imaged in her mind was the configuration of the memory reconstruction virus. The results of the initial clinical tests were spectacular, but not everything was neat and clean. It was now clear that success was determined by various factors, including the time between onset of symptoms, physical health of the subject—there were even some simulations that indicated that individuals who were rarely exposed to preservatives or certain types of petroleum products, or who had been careful to eat well-balanced meals throughout their lives stood a better chance of recovering a larger portion of their memories—and current age. The virus ViroMax had designed helped to reconstruct damaged links between memory recall and storage by stimulating growth in nerve cells.

When she finally backed away from the screen, she had what she thought she wanted. She typed in a command that would set an automated, elaborately protected lab to manufacturing the viruses. In twenty to forty hours there would be sufficient product to conduct thousands of tests. In an hour there would be enough for her purpose.

The back door was still unlocked when she pulled into the barnyard very early Sunday morning. Rachel rolled into bed without a sound, gently setting the shoulder bag on Eric and Ernie's old desk. She peeled her clothes off and slipped into an old flannel shirt Eric had passed on to her years ago. She fingered it briefly, savoring the smooth, worn material. She lifted it to her face and breathed in. The odor of hay and sweat—a scent so distinct, she recalled abruptly a day he'd worn it. He'd been sixteen, she only twelve. Not long after, she'd asked for it and he'd laughed and given it to her.

She slipped it over her head, and her mind drifting in memories, she fell asleep.

Rachel woke to a silent house. The only smell was from decades of early morning pots of coffee and fried, roasted, or baked pork. Cold light edged the green plaid curtains that were closed over the bedroom window. Rachel stood and picked up the shoulder bag, carrying it into the family room. The fire was long dead, and Mom had drawn the shade over the picture window while she was gone. She tugged it down and it rolled up. Thick gray clouds scudded before a brisk wind. Snowflakes blew sidewise across the window. Sometimes she could see all the way down to the Duerkops. Other times, she couldn't even see the edge of the field.

She went to the kitchen. A note sat on the table. She picked it up. It read, "Dad comes home today. Between 12-3. Come if you want."

She took a deep breath, then started setting up the equipment.

When they showed up at quarter past one, she was ready. She ran out to meet them as Mom pulled up in the old station wagon.

She opened Dad's door. He smiled faintly up at her, then grunted as he got out of the car. She took him by the elbow, and said, "I made us some lunch."

He grunted again and said, "It'll be a damn sight better than that hospital garbage they served me."

"Chuck! Watch your language," Mom snapped.

He grunted again, but said, "Sorry, Hon. It was bad, though."

She nodded, conceding the point as they went into the mudroom and then into the kitchen.

The aroma of a bread-and-butter pork roast wrapped around them, all the more rich for the cold, snowy air outside. Dad shot her a glance, then smiled.

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Genuinely this time. "My favorite," he said.

Mom smiled, too when she saw that Rachel had set the dining room table rather than the kitchen table. The old china, painted with faded roses and stems; set off the faintly tarnished silver and crystal goblets she'd arranged over a maroon, tie-dyed table cloth she'd sent them from Liberia, long ago.

Mom said, "I'll just get—"

"It's all ready, Mom. Just have a seat and I'll get the sparkling juice." Rachel ushered them into the dining room.

Mom giggled and said, "I feel like I'm in a restaurant."

Rachel smiled as she retrieved the sparkling grape juice from the mud room. It was cold enough to frost slightly in the damp heat of the kitchen. She set it on the table as her parents washed up and then pulled up to the table.

Rachel retrieved the roast from the oven, deftly lifting it from the roaster and onto the china serving platter. Fragrant steam rose from the tender meat. She spooned the soft potatoes and carrots and onions from the juices in the roaster and arranged them neatly around the cut. She placed it in the open spot in the center of the table and returned to the kitchen for a loaf of bread from the town bakery. She sat down.

"I'd like to say the grace this afternoon, if you don't mind," Rachel said.

Her parents looked at her, then at each other—then at her again. She laughed. "Don't be so surprised! Maybe I'm coming back to my roots now that I'm getting old and gray."

Dad nodded, bowed his head and squeezed her hand. Mom did the same. Rachel said, "Come, Lord Jesus, be our guest. Thank you, Lord, for bringing Dad safely home—and for bringing me back home, too. Bless us now as we eat and fellowship together, and use this food to strengthen us to serve you better. Amen."

They repeated her "amen," then squeezed her hands tightly.

They ate and drank and chatted about nothing in particular. Rachel watched them closely. Toward the end of their meal, they both began to lapse into longer and longer periods of silence. Their words seemed to slur together as they appeared to lose their train of thought. Finally both sat silent, staring vacantly into space.

Rachel sagged back in her chair. For a moment, she could feel her head throbbing. Though she'd thought this through a dozen times, she still had doubts about it. Ethical qualms. Moral instability.

She took a sheet of paper from her back pocket. She looked at Dad. Degraded brain cells were experiencing rapid growth, reconnecting areas that had long been disconnected. He would be remembering incidents, scents, sounds, sights, tastes and touches he didn't even know he'd forgotten.

She started to read aloud. It was a simple story, really. As the cells regrew and were hyperstimulated, audio input would theoretically create accompanying multisensory input to match the words. Whatever they heard would become a complete memory—whether it had happened or not. If it worked the way they thought it would, an Alzheimer's patient would need to be in isolation for the period of regrowth or risk introducing memories that had never really happened. Memories that would be indistinguishable from events that had actually occurred.

Furman had called it the miracle drug of the Twenties. The Right and Left jointly denounced it as the ideal brainwashing drug.

Her story was finished before her other thoughts were.

She sat in silence with her parents. After an hour or so, they started talking again.

Dad said, "I got a sore throat. How about a cup of honey-lemon tea, Hon?"

Mom stood up, blinking as if she'd just awakened. But she worked slowly and by the time she presented the tea to

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Dad, she was merely blinking as if she'd been dazzled by a bright light.

"So, when are you and Mom moving out?" Rachel asked, her pulse roaring in her ears.

"Well dear, the movers will be here Monday. Dad and I will be going to spend a few days with your Auntie June in Rochester." She shrugged. "When we get back into town, everything will have been moved to the new condo." She frowned slightly as she sat down with a cup of tea for herself. "We showed you the place, didn't we, Rach?"

Rachel nodded, watching Dad drink the tea. He rubbed his neck once and her heart froze. But he didn't say anything else. They sat wrapped in a quiet, warm quilt of golden light over the remains of dinner.

In the family room, she'd built a fire and her magazine lay waiting for her. Instead, she said, "Why don't you let me get the dishes, Mom, while Dad goes out to the barn?"

Her mom smiled and waved at her. "Nonsense, Rach. You cooked, I'll clean up. You just scoot to your chair by the fire. I'll take care of this."

Dad stood and headed for the mud room, just like he had for all the years Rachel could ever remember. He'd always looked forward to retirement. And now he was moving Monday because he and his wife were tired and wanted to spend the last years of their lives dancing, seeing movies, traveling, and enjoying one another. There was no bitterness. He wasn't being forced out of his home. He had never tried to hang himself in the barn. Rachel shuddered at the memory of that night.

She padded in stockinged feet into the family room and sat down slowly, pulling the multicolored afghan over her lap. She stared at the crackling fire. Without thinking, she reached back and played with her braid—a single pigtail, really. She tugged at it, then absently put the tip of it into her mouth. A moment later, she pulled it free, staring at it. She thought she'd broken that habit ages ago. She smiled faintly and settled back into the chair. She read until late, Dad first, then Mom stopping briefly to say their goodnights.

By the time her eyes were tired, it was after one. She clicked off the lamp, then sat and stared at the glowing embers of the fire, listening to the wind blow snow against the window. Beside her sat the case she'd brought from Chicago. Inside, a second dose of the memory reconstruction virus nested beside its empty twin. In her pocket a long, involved letter she'd written for herself. She pulled it out and smoothed it on the afghan resting on her knees. It began, "You are a lab tech in a big city. A perpetrator of alcoholic-type behavior, you lost your husband and your children. You are jobless. Destitute. Your behavior has been successfully treated. Your parents gave you a plane ticket to Chicago in order to reconcile your marriage. You have always loved your husband—you still love him. He will completely satisfy you. . . ."

When the words grew blurry, she stopped and folded the sheet of paper in thirds, swallowing hard against the urge to cry.

She stood up and headed for bed, leaving the case by the chair in the dim light of the quarter moon shining through the window. In the morning, she would be ready to begin again. Forever.■

It is a wearisome disease to preserve health by too strict a regimen.

—François de la Rochefoucauld

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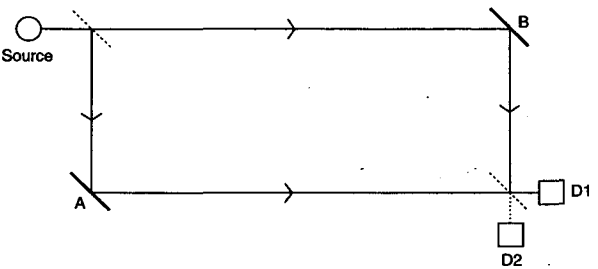
"INTERACTION-FREE" QUANTUM MEASUREMENT AND IMAGING

In 1993 Elitzur and Vaidmann (EV) showed a surprised physics community that quantum mechanics permits the use of light to examine an object without a single photon of the light actually interacting with the object. The EV thought-experiment requires only the *possibility* of an interaction. More recently physicists at Los Alamos and Innsbruck have demonstrated the effect experimentally with an improved version of the EV scheme, have accomplished interaction-free imaging, and have boosted the efficiency of the process from 33 percent to over 75 percent.

The EV scheme was originally described as a thought experiment using a set of "photon-triggered bombs," and I'll use this bomb scenario to give the procedure more immediacy. Suppose that you are given a set of photon-triggered bombs housed in light-proof cases. There is a hole in each bomb through which light may pass. Some of the devices are "live" bombs, constructed so that when any single photon of light enters the hole, the bomb explodes. But there are also "dud" bombs that will allow any photon to pass completely through the hole and exit without an explosion. You are given the task of identifying as many devices as possible that are *certain* to be live bombs but that have not yet been detonated.

From the point of view of classical physics, this problem is impossible to solve. If all the devices are exposed to photons, the live bombs will all be destroyed and only the dud bombs will remain. However, the EV scheme employs the peculiarities of quantum mechanics to solve the problem. A signal can be derived from a quantum interferometer testing when there is only the *possibility* that the bomb will explode, even when it does not actually do so.

The apparatus that makes this test possible is called a Mach-Zender interferometer, a standard optical tool frequently used to measure the index of refraction of gases. The interferometer uses a 50%–50% beam splitter to divide incoming light into two beams. These beams are then deflected by 90° mirrors along paths that form a rectangle. They meet at a second beam splitter, which recombines them. The combined beams then go to one of two photon detectors. The diagram shows a Mach-Zender interferometer.



Suppose that we use a light source

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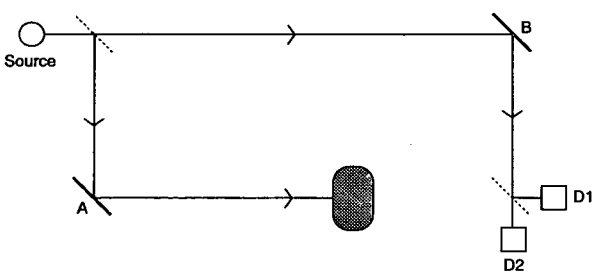
that can emit photons one at a time, on command. A photon emerges from the source and passes through the upper beam-splitter (upper dotted line), which has the characteristic that 50 percent of the time the photon will be reflected by 90° and 50 percent of the time it will be transmitted straight through. It may then travel to mirror A or to mirror B (solid lines) where it will be reflected by 90°. Along either path, the photon reaches the lower beam-splitter (lower dotted line), where it may again be transmitted or reflected, reaching either photon detector D1 or photon detector D2.

A Mach-Zender interferometer has the peculiarity that, if the paths between the beam-splitters have precisely the same path lengths, *all* photons will go to detector D1 and none will go to detector D2. The single photon must be treated as a wave that travels along both paths. After each beam-splitter, the emerging reflected wave is 90° out of phase with the emerging transmitted wave. This causes the waves at detector D1 to be in phase and to reinforce, while the waves at detector D2 will be 180° out of phase and will cancel.

Now suppose that we place an opaque object on the lower path after mirror A. It will block light waves along the lower path, insuring that all of the light arriving at the lower beam splitter had come along the upper path and been reflected by mirror B. In this case, there is no interference, and the lower beam splitter sends equal components of the incident wave into the two detectors.



Thus, if we do the single photon measurement with no opaque object, we should detect the photon at D1 100 percent of the time. If we do the same measurement with the opaque object blocking the lower path, we should detect a photon at D1 25 percent of the time, a photon at D2 25 percent of the time, and detect no photon at all 50 percent of the time (because it was absorbed). In other words, the detection of a photon at D2 *guarantees* that an opaque object is blocking the lower path (but has not actually intercepted the photon). Detecting a photon at detector D1, on the other hand, gives no information on whether or not an object blocks the lower path.

One of the peculiarities of quantum mechanics, which distinguishes it from classical physics, is called the "collapse of the wave function." In a situation like the one described here, in which light waves that travel along two paths can interfere, that interference can take place only if we have no way of determining which path was taken. Any measurement that determines the path will "collapse" the wave function to that particular path, after which there can be no two-path interference.

Now, in a completely light-free laboratory, we place a photon-triggered bomb in the lower path, so that photons from the source will pass through the bomb's hole. If the bomb is live, then sending a single photon through its hole constitutes a "which-path" measurement. If the bomb explodes, we know that the photon took the lower path. If it does not explode, we know that the photon took the upper path. In either case, the wave function collapses to the indicated path. Therefore, if we detect a photon in detector D2 in this situation, it means that a photon did not take the lower path. In

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this case, we are guaranteed that the object in the lower path is a live bomb rather than a dud. Although no photon has reached it and it has not exploded, we have identified a live bomb. The EV scheme detects the *possibility* of a photon interaction with the bomb, even though no photon actually interacts with it. The photon that might have interacted with it has instead traveled along the upper path via mirror B.

If we perform this test on the set of photon-triggered bombs, 50 percent of the time the bomb will explode, 25 percent of the time we will receive an inconclusive D1 signal, and 25 percent of the time we will receive a D2 signal indicating an unexploded live bomb. If the test gives a D1 signal, we gain no information, but we can send in another photon and try again. The net result is that we will be able to identify one third of the live bombs while exploding two thirds of them, on average.

In 1998 a group of physicists from Los Alamos National Laboratory and Innsbruck, Austria, reported that they had used an improved version of the EV technique to produce actual interaction-free high-resolution profiles of small objects (a knife-edge, a wire, a hair, an open slit). They used events in which no photons interact with the objects being "viewed" and plotted their profiles.

The same group, led by Paul Kwiat of Los Alamos, has devised a technique for improving the efficiency of the EV procedure, in effect reducing the number of exploded bombs to zero in the above example. They use another peculiarity of quantum mechanics associated with wave function collapse and called the quantum Zeno effect.

"The Problem of the Arrow" is one of the paradoxes proposed by the Greek philosopher Zeno of Elea. Imagine an arrow in flight. At some instant during its flight, it is in a fixed position. At another instant it is in another fixed position. In fact, at any instant, its position is always fixed. When, Zeno asked, does the arrow move? It is as if the act of examining the arrow's position prevents its motion.

At the end of the 1960s, several groups of theoretical physicists noticed that quantum mechanics contained the analog of Zeno's arrow paradox. Suppose you have a photon that is initially polarized horizontally (H) but that passes through an series of optical elements that progressively make small rotations of its polarization direction. Their cumulative effect is to rotate the photon's polarization to vertical (V).

However, quantum measurements are peculiar. We cannot simply *measure* a photon's polarization direction. Instead, we must pass it through a horizontal (H) polarizing filter and see if it survives. If so, it has H polarization, if not, it has V. Moreover, the measurement collapses the wave function, which resets the photon's polarization to be *precisely* H (or V).

Therefore, if after each rotator we place an H polarization filter, the photon is repeatedly reset to H and must emerge with H polarization. This is the quantum Zeno effect, the quantum equivalent of "a watched pot never boils." A "watched" (repeatedly measured) photon can't change its polarization, while a photon not watched can change its polarization freely.

Kwiat and his group applied the quantum Zeno effect to horizontally polarized photons that are recycled through one optical device that rotates the polarization orientation by a small angle. The photon proceeds to a splitter that transmits V polarization and reflects H polarization. Because there was only a tiny rotation in the polarization, the probability of transmission (V) is much weaker than that of reflection (H). This split is followed by mirrors and a device that recombines light on the H and V paths back into one beam.

The EV test is made by sending a single photon into the apparatus and inter-

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cepting the weak V beam path with an opaque object (the equivalent of passing it through the bomb's hole). The apparatus is arranged so the light is repeatedly cycled through, so there are many successive EV tests using the V component of the beam.

The net result is that if no object (or a dud bomb) is in the V path, there is no measurement and the recycled light beam after a number of passes will rotate from H to V polarization. However, if an opaque object (or live bomb) is in the V-beam, the survival of the photon constitutes a path measurement, and the photon polarization is repeatedly reset to the H polarization state. Therefore, final H polarization of the photon indicates the presence of an opaque object (or a live bomb) in the V path, while final V polarization of the photon indicates no opaque object (or a dud bomb) in the V path.

The group has shown that if the beam makes N passes through the system and the polarization rotator changes the polarization direction by an angle of 90° / N on each pass, the probability that the photon will interact with the opaque object (or the bomb will explode) is $P(N) = 1 - [\mathrm{Cos}(90° / N)]^{2N}$, a probability that decreases roughly as 1 / N as the number of passes N is made large. For example, with 10 passes the probability of explosion is about 22 percent, with 100 passes it is 2.4 percent, and so on. The group has demonstrated the equivalent of these theoretical results (without using actual bombs) in the laboratory, achieving 75 percent efficiency and showing that at least 85 percent is feasible.

This amazing technique is still in its infancy, but it has interesting implications. It might be used on biological molecules that are light-sensitive and might be altered or destroyed by interaction with a photon, or on atomic systems where the act of measurement alters their properties. Another application is quantum computing. A non-interacting connection to a quantum computing element entangles the photon with the state of the system, permitting transfer of uncollapsed quantum information to another part of the system. Effectively, the quantum information is teleported from one part of the computer to another.

The prospect of making a measurement without an actual interaction should also have some interesting implications for hard SF. *Analog* writers please take note! ■

AV Columns Online: Electronic reprints of 97 or so past "The Alternate View" columns by John G. Cramer, previously published in *Analog*, are available online at the URL: <*http://www.npl.washington.edu/av*>. Preprints of papers referenced below can be obtained at: <*http://xxx.lanl.gov*>.

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UNTHINKABLE

Sean McMullen

The exact shape of progress is hard to foresee because there are so many ways to look at it. . . .

How does one think through the unthinkable? Andrews was the sort who analyzed the situation in the most minute detail possible. His supervisor, Westall, was so shocked that he could do no more than stare at a thin cone of light on one of the monitors in the helicopter's cabin.

"You have to give them credit for sheer guts," said Andrews, looking up from the screen of his lapcom.

"March 17th, 2018, the worst day of my life," replied Westall morosely.

The light on the screen winked out, and the broadcast switched to NASA's command center in Houston.

"*Albatross* has successfully achieved transfer orbit after a burn of—" began an official.

Westall hit the mute key on his remote. "I almost wish they'd lose it," he admitted softly.

"There's a long way to go," Andrews began.

"Where the hell did Carrington get all that stuff?" Westall suddenly shouted. "The last NASA estimate was around seven trillion dollars for a manned Mars expedition."

"His crew is actually one woman," Andrews pointed out, then immediately thought the better of it. "And, ah, Carrington is taking risks that NASA would not. The basic idea is in the name. The albatross is a bird that flies incredible distances with very little wing movement. It could fly around the world on less than a millionth of the energy that an aircraft needs."

Westall glared at him, then rested his chin between his hands and shook his head. A clean-shaven man of about forty in a neat suit was being interviewed on the silent screen. Westall shut his eyes.

"How?" he asked simply. "How could he develop something like that in secret? Who backed him? The Arabs? The Chinese?"

"Dreamweaver Movie Finance, Leading Edge Funding, Peterson Investment—" Andrews began reading after tapping a few keys.

"They're American companies."

"There are thirty finance companies involved, and twenty seven are American. The project manager sold it as a movie on Mars, and they bought it on the strength of his reputation. Carrington is a superb movie director, project manager, and quite a visionary and dreamer, too."

"Why isn't he working for NASA, ESA, or NASDA?"

"Would you have hired him?"

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"How did my strategic planners miss the fact that space technology had become cheap enough to do something like this? How did everyone else miss it?"

"With respect, sir, the idea has been building up for over twenty years. I recall an item called "The Artemis Project" in *Analog* magazine back in the 1990s. It involved a movie company setting up a lunar colony."

"I don't recall seeing it in my technical abstracts register."

"That may be because *Analog* is a science fiction magazine."

"Science fiction? Neither I nor my planners share your interest in escapist dreams."

"With respect, sir, that appears to be the trouble. In fact, I believe there's a company still trying to do it."

"Sounds like they're going nowhere."

Andrews tapped at his keys. "Interesting, that company's among Carrington's backers! This should give their colony project quite a boost."

Westall's face reddened, then he shook his head. None of the world's large national space agencies would have funded something as unlikely as *Albatross*. Andrews tapped in silence for a minute, then sat back and stared at his lapcom in satisfaction. In the two hours since the engine of *Albatross* had been fired and the announcement made to an incredulous world, he had tracked down, analyzed and costed all the components of the first human expedition to Mars.

"Nothing new was developed," he announced. "I've sourced the major components. Try to guess what it cost. Go on, try."

"I'm in no mood for games," responded Westall ominously. "Suppose you tell me what you found before I'm overcome by the urge to push that hatch open and drop you two thousand feet onto suburban Washington."

"Okay, okay. For starters, *Albatross* is 100 percent known tech, and cost about $90 million."

"That's impossible!"

"Not so. The core hardware is very light, and doesn't need much grunt to move it. Sky Shells of Seattle sold Carrington the LP-10 Getaway environment shell for $8 million. Their share price has gone over the moon in two hours."

"Power plant?"

"A Vostok Industries ion cavitation engine."

"NASA's version of the ICE is seven times more efficient."

"And costs $400 million per year to lease. The Russian ICE was a steal at just $1.5 million per month, linked to an indexed percentage of their share price. Their shares have gone up 3,000 percent in the last two hours, so—"

"So Carrington gets the damn engine free."

"Effectively."

On the screen a window cut to the helmeted face of the astronaut, Heather Willis. Her image was clear, coming from a state-of-the-art but off-the-shelf camera-transceiver by ActionCam of Canada. The distinctive logo of her British Technowear space suit was just above the visor.

"Lease on one Technowear space suit for the duration of the journey, $75,380 per month plus an offset from a publicity A/D clause," said Andrews, bringing up a new suite of figures.

"A/D clause?"

"Appreciation/Depreciation."

"Yeah, yeah, clever, so they'll get it for free. If she gets back the Brits will have the first space suit used on Mars, which will be worth several times its weight in gold."

Westall's cell phone rang. He glanced at the number on the display, then thumbed the key and closed his eyes.

"Westall. Yes, I am watching it, sir. I realize that, sir. I suppose he would be, sir. We're working on it, sir. About $90 million, sir. Yes, I know the toilet on NASA's design cost more than that, sir. I'll have it when I land, sir. Ten minutes, sir."

Westall lowered the cell phone and sat staring blankly at the screen.

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"The president?" asked Andrews.

"No, the head of NASA, who has just been watching the head of the CIA being kicked around the Oval Office by the very, very angry president. The president is currently broadcasting his good wishes to Heather Willis. Next it's our turn in to face him."

"I'm onto it, you'll have a brief in ten—"

"*We*, not me. *We* are going to help our boss answer the most awkward presidential questions since *Sputnik, Lunik, Vostok, Challenger,* and the Hubble Space Telescope, so hurry up and finish your walkthrough."

"Okay then, the descent stage has a commercial thermal shield by Airbus Industries, the chute, cabin, and landing gear are by Hispano Custom Ballooning of Spain, and the solid fuel ascent engines are by Tsein Reaction Technologies, China. The Sunwing company of Australia did the inflatable solar panels, the collapsible Mars Flyer was by All-American Recreational Ultralights—"

"What?"

"With a modified hydrogen-inflated airfoil coated with solar cells, also by Sunwing, as a supplement to the hybrid electro-catalytic engine from Nissan. Now that last item was non-standard, cost $21 million and took two years to develop."

"Don't tell me, Carrington has shares in the patent."

"Er . . . yes. United Airlines lifted their astronaut to Novatel Spatiale, the French orbital hotel. A Boeing orbital robot assembler was leased to snap the modules together. The assembler also ferried Willis to *Albatross*."

"Something just doesn't add up. To reach Mars you need an enormous volume of propellant."

"That came from Novatel Spatiale's stores. Remember that load of contaminated water kept in an old space shuttle tank? Guess who bought it cheap?"

"But it was tainted with hydrocarbons."

"Sure. You can't drink it, but you can use it in a Russian ion cavitation engine powered by an inflatable Australian solar array the size of a football field."

"And behind it all was a movie producer!" muttered Westall.

"It makes sense. Carrington's spent his life using other people's money to fund big budget productions, and always turned in a profit. His last two movies were shot in orbit under pretty tight secrecy, so people assumed that this was just another movie. In a sense it is, too. With all this publicity, even the raw footage will be the biggest box-office draw since *Star Wars*. Carrington will make a profit from *Albatross*."

"There are plenty of others who want that sort of publicity. What's next? Disney comedies on Venus? Lucasfilm epics on Io? Kentucky Fried Chicken commercials on Phobos?"

"In terms of capital investment all three of those organizations could probably finance—"

"This can't be! Our experts said seven trillion to reach Mars."

"But that was for a crew of five. They were to be awake the whole time, so food, fluids, artificial gravity and other overheads raised the weight and cost. *Albatross* carries one female geologist who weighs ninety pounds in her briefs and sportsbra—both made by Sportsgirl, by the way. Her hobby is ultralight flying, and she won the Scotland to Newfoundland ultralight race in 2015. She's light, bright, brave, tough, and resourceful."

"Pilot, technician, and scientist all in one," sighed Westall.

"She will be in deep hibernation for most of the trip, cutting bone calcium loss and muscle decline to below 2 percent. Hibernation chamber by HyberDyne of Scotland. It's a lightweight, portable model for shutting down seriously injured patients in remote areas until they reach a hospital. Costs $270,000 and weighs 310 pounds. When she's awake there's food concen-

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trates by Orbital Epicure of London. The plan is to have her awake for a total of two weeks in space and four on Mars."

"That's cutting it fine."

"Maybe so, but there she is," he said with a gesture to the screen.

Westall restored the sound. Willis gave a farewell message to all of Earth, then the coverage cut to Carrington. He began explaining that they considered the Hitachi orbital navigation computer to be so reliable that they neither included a backup, nor used a second computer for the landing stage. One plug-in module did everything. Andrews typed at his laptop and figures reeled across his lapcom. $47,000 for the navigation computer and $6,740 for the Microsoft software.

"Mr. Carrington, what we all want to know is how you got the idea?" asked an interviewer.

"Six years ago I saw the wreck of an old Dutch sailing ship in an Australian museum. Did you know that the Dutch first reached Australia in 1606, but it was not until 1770 that the British discovered the fertile east coast? The sensible, cost-conscious Dutch merchants from the Spice Islands saw a red desert on the west coast, so in 164 years they didn't bother to fit out a single ship to check the entire coastline. That night I saw Mars in the sky and I thought, well, there's another red desert, and unless someone fits out a ship to go there we might wait another 164 years to discover the good bits on Mars. Did you know that NASA had the technology to land humans on Mars in the 1970s—"

"Yes, yes, and my father told a Senate committee so at the time!" Westall shouted at the screen, "Do you think his sensible, cost-conscious political masters listened? Did they listen forty years later, when I told them—again?"

He snatched up the remote and killed the screen. The helicopter was descending now, to a White House lawn teeming with journalists, police, officials, and the National Guard.

"Ready?" asked Andrews.

"To explain the unthinkable? Never."

"What do you think he might ask?"

"Why will a country with a population smaller than that of Washington, D.C., beat the United States, Russia, Europe, China, and Japan to Mars?"

"That's easy. *Albatross* was globally outsourced. The whole world helped build it."

"I'm afraid the whole world is not seeing it that way."

"We just need to put the right spin on the story, hype up the global contribution. After all, 90 percent of the venture capital was American. Creative PR can explain that. Carrington's country provided nothing but the project manager and logo."

"Maybe so, but I say that all the hype, spin, and creative PR in the world will never, never explain why the words on that logo are 'Made in New Zealand'."

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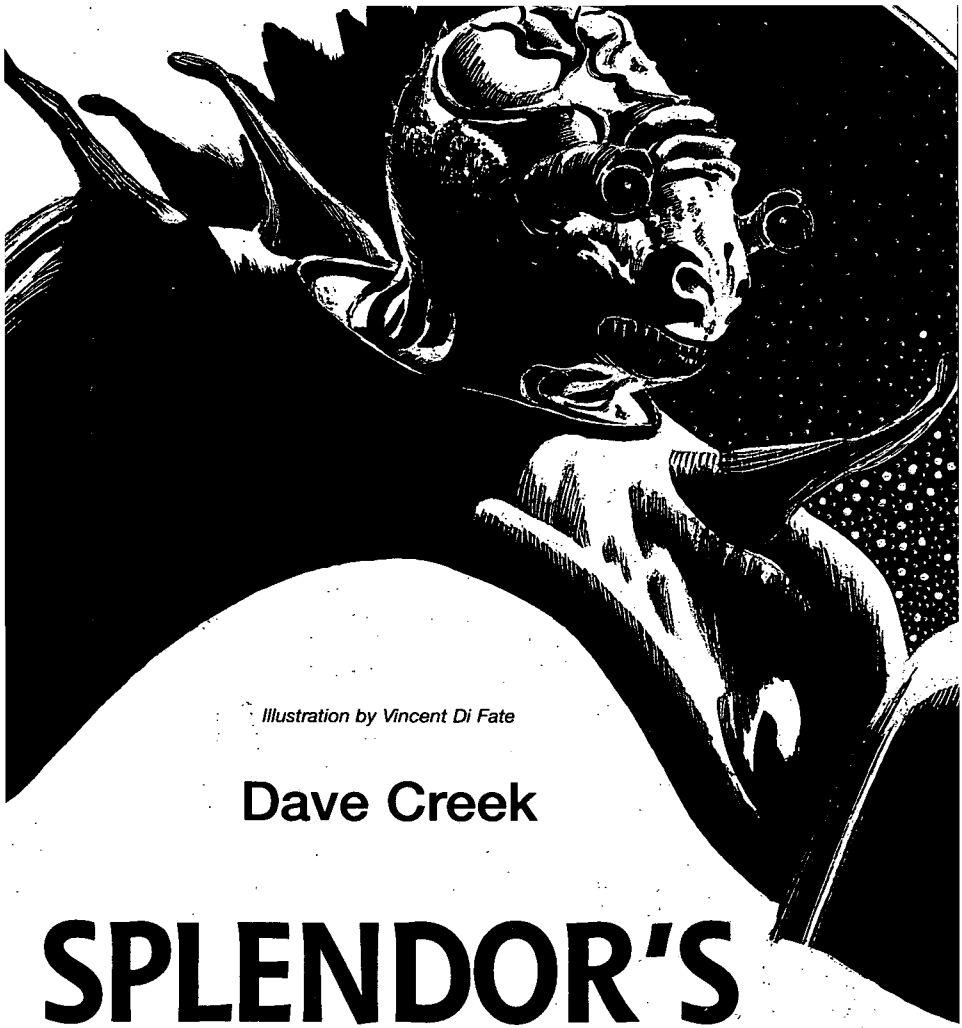

Illustration by Vincent Di Fate

Dave Creek

SPLENDOR'S LAWS

Diplomacy has never been simple, and the more different species are involved the more complicated it gets!

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In the jungles of the doomed ice planet. . . .

Though it isn't much of a jungle, Earth Unity Ambassador Chanda Kasmira reflected as she and the valley dweller D'jirar neared the atrocity site. She'd arrived here aboard the Unity diplomatic starcraft *Nivara,* now orbiting Splendor.

Most Splendorian trees barely topped three meters, essentially huddling close to the ground to capture its warmth. The vegetation between the trees had thick, almost leathery leaves that retained water well, and were splashed red, yellow, and orange to entice Splendor's scarce insectile flyers into spreading their seeds.

"We're getting close," D'jirar said. "I can smell burned trees." The valley dweller's skin had a greenish cast and was lightly scaled. One of Chanda's colleagues had told her D'jirar's hue complemented Chanda's own creamy brown skin nicely. *A matched set* was the phrase he'd used.

She'd see. D'jirar had been the first valley dweller Humans had contacted eight years earlier, and since then had helped dozens of Splendorian tribes come to terms with the simple fact that they must leave this planet or future generations would die. The Unity starcraft *Erasmus* had spent the last eight years spreading the word about the danger and ferrying valley dwellers and highlanders to their new, and it was hoped, temporary, homeworlds. It was orbiting Splendor during the attack, but didn't detect anything until the village was destroyed.

The Sobrenian craft that now orbited Splendor had also gone unnoticed until after the attack. Sobrenians were an aggressive species and weapons tech was their highest art form. When the starcraft wouldn't respond to the *Erasmus*'s captain, the Unity dispatched Chanda aboard the *Nivara.* Though the Sobrenians hadn't yet responded to the *Nivara,* either.

Sometimes it was frustrating, this hopping from one planet to another, "putting out fires," as diplomats sometimes called it. Chanda preferred no other life, though. No sitting in an embassy for her.

Chanda and D'jirar had landed in a clearing half a kilometer away to avoid disturbing the attack site. Now Chanda climbed over a mass of thickvine half a meter high and too wide to walk around. She wasn't used to the heat. For Splendor, 28° C was pretty warm. The planet's grav, a third again that of Earth, didn't help either.

She looked back at D'jirar, wondering if she needed help getting over the thickvine. The valley dweller's head was barely level with Chanda's shoulders, and Chanda herself was only 180 centimeters tall. Should have known better, she thought, as D'jirar used her strong thick legs and sharp-clawed toes to scramble over the mass, with her thick tail waving from side to side for balance.

The valley dwellers were one of the two intelligent species Splendor boasted. D'jirar's people lived within volcanically-heated valleys in the icy regions that dominated Splendor's land area, or here in the warmer climes of the equator. They were proficient in crafting metal tools and weapons. The other Splendorian species, the highlanders, lived only in the icy areas, and traded furs for valley dweller tools.

It would have seemed an idyllic existence to Chanda, except for one problem, a big one. In just over ninety years, a nebula of hot gas from a star gone supernova over ten thousand years earlier would render Splendor uninhabitable. Worse, no one had yet found a world that could accommodate both species. The highlanders were being relocated to a planet in the Socrates system, the valley dwellers to a world in the Kardashev system.

Chanda told D'jirar, "You didn't have to come along." She heard the valley dweller's translated reply over her

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datalink: "If I want to become a spacer, I must learn all I can. That includes learning what happened here."

One moment, Chanda was walking through a forest with the rays from Splendor's primary, Pinpoint, barely glimpsed as they danced among tree leaves. The next, she was squinting against Pinpoint's steady glare as it shone down unimpeded from an empty sky.

The destruction stretched nearly a kilometer across, its edge disturbingly neat and surgical. The landscape was barren; scattered stumps of trees, bits of thickvine, a shard of a valley dweller's cup or bowl were all that lay upon the earth before them. After a recorder drone from the *Nivara* that resembled a silvery baseball passed overhead, all was quiet. Splendor's equivalents of insects and birds were less prevalent on Splendor than on Earth, but Chanda hadn't realized how much the occasional flutter of wings or *churruping* of tiny legs were part of the background noise you took for granted. The skies seemed . . . *empty,* washed clean of life.

Chanda had viewed the destruction from the orbiting *Nivara,* and knew it extended another nine and a half kilometers from their position.

D'jirar said, "Many sixteens of valley dwellers lived here. What did they do, that the Sobrenians would kill them?"

Chanda said, "I think they were just in the way. The Sobrenians may consider this planet already dead."

D'jirar looked toward the sky, as if the wisps of cloud there might spell out an answer. "It is not. And should not be before its time." The valley dweller's gaze returned to Chanda. "Do you expect to hear from the Sobrenians soon?"

"They're not given to rapid replies, in what little experience Humanity has had with them."

"Then I must ask you a favor."

Damn, it's cold, was Chanda's only thought as she stepped out of the *Nivara*'s shuttle right behind D'jirar, at the valley dweller's home village. She gathered the collar of her jacket more closely around her neck. A lifesuit's energy field could have kept her warmer, but that was too removed from the experience. She *wanted* to feel the chill air in her lungs, to see her breath.

This was a more typical (as much as any single area could be typical of a whole planet) site on Splendor. Chanda had seldom seen the phrase "red-hot" made real, but the lava flow that traveled right past the village certainly exemplified it. And that wayward whiff of hellfire—how did they stand it?

Beyond the volcanic flow, beyond the line of too-short trees that marked the end of the valley dwellers' micro-ecology and the beginning of highlander territory—incredible! Chanda knew that Earth, with its lower gravitation, sported taller mountains, but the sheer number of them here on Splendor amazed her. The nearest ones vaulted thousands of meters above the village, casting long shadows across the plain. Then they went on in layer after layer, to the horizon and over it.

Most all the villagers had dropped what they were doing, whether hammering raw iron into spears, tracking the lava flow, or working a bellows, to witness the return of one of their own, and the latest Human to visit them. As they gathered around, D'jirar bounded ahead, making a path through the crowd.

Chanda, without thinking, had expected to see curiosity in the faces around her, perhaps even some fear. Instead, the villagers crowded around her as she took her heavy 1.3 *g* steps toward A'doranon's hut, but as one greets the friend of a friend, not a curiosity from another world. I was foolish, Chanda thought. These people first made contact with Humans eight years ago. Many of them knew the sacred Mike Christopher, after all.

These valley dwellers were slated to

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be the next ones evacuated to the Kardashev system, and D'jirar had asked for a quick visit, fearing the negotiations with the Sobrenians would make her miss their departure.

A'doranon stood in front of her hut. She was older than D'jirar, and taller, meaning the top of her head was about level with the bottom of Chanda's chin. D'jirar embraced A'doranon briefly, then rushed into the hut, presumably to see her niece U'tarna.

A'doranon said, "I am glad to meet D'jirar's new friend."

Chanda's eyebrows raised. "You have a datalink!"

"I asked the Humans from the *Erasmus* to plant this tool within me. I have had many contacts with Humans. It has been very helpful."

A'doranon led Chanda into her hut. Chanda ducked to enter. D'jirar was there, with her arm around a young valley dweller's shoulders. She said, "This is U'tarna."

The youngster had shiny, bright green scales, soft eyes, and an active tail. "Glad to meet you," Chanda said.

D'jirar translated for Chanda, and U'tarna replied rather extensively. D'jirar said, "She is happy to see you, as well. And she wonders when we may leave for Kardashev, and when she may receive a datalink."

"Goodness, she's an eager little girl."

A'doranon said, "She is always talking about space, about Humans. She has the wandering blood in her, as D'jirar does."

Chanda said, "Well, the *Erasmus* should be here soon. When it is, this village should finally be able to go. And they can implant the datalink aboard ship."

Another translation and response. "U'tarna thanks you," D'jirar said. "And I thank you, as well, for allowing me to see my loved ones before they leave this planet. I want to learn spacer ways, not just understand your tools. And when U'tarna is grown, which will be soon, she wishes to become a spacer herself."

Chanda asked, "And what are your plans? After these negotiations?"

"I will leave here to be with my people on Kardashev for a time. Then I will travel to new worlds, as Humans do. It will be difficult for them to learn the ways of a new world. Also to live without highlanders. I can help."

Chanda nodded. "I'll make sure you follow them as quickly as possible. But first, we have to stop the Sobrenians."

Chanda and D'jirar lifted back to the *Nivara*, a starcraft twenty crewmembers strong which specialized in diplomatic ventures. Its weaponry was minimal, but its small shuttle was ideal for quick jaunts to a planetary surface. Chanda feared its larger evacuation shuttle might be needed soon. The sixty-meter-long *Nivara* itself was capable of a planetary touchdown in an emergency, but wasn't equipped to hold passengers. She'd had this starcraft and its crew assigned to her for some five years, and they worked together well.

Chanda took D'jirar right to the bridge so she could meet the *Nivara*'s commander, Trenton Bram. The introductions were brief, though. Bram told them, "The Sobrenian ship just replied. Commander Domerlan has agreed to meet with you both."

"Are you making preparations for his arrival?"

"No. He expects you over on his ship. Immediately."

"Why do I get the idea I'm being summoned?"

Captain Bram said, "Maybe because you are. Be careful over there."

D'jirar's tail thumped nervously against the deck. "He would not harm an ambassador, would he?"

Chanda said, "It's hard to say. Sobrenians have a low opinion of most other Galactic species. Check that—of *all* other Galactic species. Are you ready?"

"I am," the valley dweller said, and followed Chanda back to the shuttle deck.

* * *

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Commander Domerlan received Chanda and D'jirar in his quarters aboard the *Melareon*. As they introduced themselves, Domerlan swiveled his wide-set eyes independently in their sockets to regard them. Try as Chanda might, she couldn't read anything into the bland expression in those disconcertingly-mobile eyes or the set of his head with its blunt snout, or in the stance of his heavily-muscled limbs or thick torso.

Domerlan's quarters were dimly lit, warm, and humid. A single chair and a simple bed, little better than a cot, were the only furnishings. A musty smell, more organic than most scents aboard a Human craft, permeated the room. Domerlan was dressed in many-layered robes whose fabric was an iridescent green with faint red and violet threads running through it. He offered no refreshments.

Domerlan spoke, and through her datalink Chanda heard, "I congratulate you on your persistence, Ambassador Kasmira. And you, D'jirar. Normally it takes many days before I allow an appointment from off-worlders. But my reverence for life has led me to see you right away, once I heard of this unfortunate incident."

Chanda shielded herself with her best diplomatic smile, though she knew it might be wasted on a Sobrenian who might not be able to read Human expressions. She glanced at their bare surroundings. "I'd expected you'd have some of your species' finest weapons displayed here in your quarters. I'd thought to compliment you on your décor."

Domerlan said, "I'm not terribly sentimental."

Pleasantries out of the way, time for the direct assault: "Perhaps that lack of sentiment explains what the Earth Unity considers, quite frankly, an atrocity."

"It was a mistake. A weapons test. We knew of no inhabitants in those jungles."

Knowledge the simplest scan could have provided. "The Unity is wondering," Chanda said, "how you came to pick this planet for your tests."

"We felt a planet that will eventually be swept of life would be ideal for our purposes."

Chanda heard the faint swishing sound of D'jirar's tail as its tip nervously swept back and forth on the hard, black floor. "Splendorians still live here," Chanda said. "These tests could upset the entire ecological balance on Splendor. The trees at the equator provide most of the planet's oxygen."

"Regrettable."

"The Unity has accepted the responsibility of evacuating this world's inhabitants."

"As I accept responsibility for this incident. But the testing will continue."

"Couldn't we agree on a moratorium while we discuss this at a higher diplomatic level, and while the Unity works to remove Splendorians from the test area?"

"My orders come from the highest level and will not change."

Chanda took a deep, calming breath. "But to bring such violence to a peaceful world—"

"Humanity has little to be smug about. I need only mention the Great Human War." *That* hit home. Four decades earlier, dozens of worlds, colonized by Humans, K'Nandra, Arols, even Chordarii, had been involved in that conflict. Among the various Galactic species, billions died. Domerlan asked, "Are you old enough to remember that conflict?"

"I was . . . young. But at least I was awake then. Fourteen subjective years old."

"Awake? I don't understand."

"Sorry. Personal history. The point is, I don't think my species' actions then have anything to do with this matter."

Domerlan smoothed the colorful folds of his robes. "Then let us look toward the future. Splendor has no strategic importance. The Unity has not established

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a military presence here, nor has it opened an embassy."

Chanda said, "There's been no need—"

"Of course there hasn't. Splendor's inhabitants are not starfarers. The world will be uninhabitable within two Sobrenian generations. Look farther ahead. Evolution works slowly here. Generations ago my own homeworld survived a massive meteor strike. We are the better for that catastrophe. The strongest rose quickly to recreate our civilization. As for Splendor, even if life arises here again, it will be too far in the future to concern us. I cannot assist you."

OK, Chanda, keep pressing. "Captain Domerlan, the Earth Unity wish good relations with the Sobrenian people. But it would be difficult to deal with those we consider to be committing genocide. If we wished someday to come to terms on trade relations—"

Domerlan *buffed* a blast of air from his nostrils. A Sobrenian laugh? "Our nanotech is already superior, allowing us to create any material possessions. Even Humanity has grown beyond a market economy. So have we."

"Perhaps scientific partnerships—"

"Sobrenian scientific knowledge is beyond Humanity's."

D'jirar took a step toward Domerlan. "You said you revere life. Was that a lie?"

Chanda cleared her throat at the valley dweller's blunt, non-diplomatic question. You pushed as hard as you could, but you never called another negotiator a liar.

Domerlan, though, was unperturbed. "I revere all life," the Sobrenian said. "However, I revere Sobrenian lives above all others, and you should know my people wonder why other Galactic species do not hold us in equal regard."

"Captain Domerlan, Splendorians are suffering. Many could still die."

"The tests are valuable to my people. They must be conducted within a livable atmosphere and a still-viable ecology, with a widely scattered population of presentients to achieve the best data. The most . . . pleasing data. The disruptor craft are unmanned, their programming complex."

D'jirar started forward and Chanda knew why, didn't blame her, but placed a hand on her shoulder anyway. Valley dwellers rarely initiated violence, but who wouldn't be angry at being classified a "presentient?" Still, if the carrot doesn't work, bring out the stick. Chanda said, "I believe the commanders of both the *Nivara* and the *Erasmus* will be more than willing to target your automated craft. And while we would not wish to target the *Melareon,* as their source—"

"That would be unwise, given our superior firepower," Domerlan said, "especially as the *Melareon* is *not* their source."

That was interesting, and perhaps a small diplomatic gift from Domerlan. "May I ask what is their source?"

Domerlan stood unmoving. "You *have* asked. I will not answer. We apologize for an inconvenience. The valley dwellers' presence was unforeseen."

"Yet you say you required a populated planet for your tests."

"I cannot dispute your conclusion. Neither can I postpone the testing, and time is limited. And any attempt to remove the remaining Splendorians before the next wave arrives will only cause the next test to be advanced. We must maintain the current population density to obtain the proper results."

"Just how limited *is* time?"

"I cannot say. You could attempt to interfere with our tests. It would detract from their artistry."

"What areas on Splendor will be targeted? Only equatorial areas?"

"I cannot comment upon specific targets. It would be wise to evacuate the equatorial areas first. It could give us interesting results." Chanda wondered, interesting because that population would be headed away from the targeted area or into it?

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D'jirar said, "This will be difficult to accomplish. These are tribes who do not know about the supernova danger. Many do not even know people other than valley dwellers and highlanders exist."

"All the same," Chanda said, "we have to help as many as we can." To Domerlan: "Can you give me an approximate time until the next test? Do we have hours? Days?"

"You have until it happens. You may leave now."

An ambassador has to be able to take a hint. Chanda gave Domerlan the slightest of nods, took D'jirar by the elbow, and got the hell out of there.

Chanda, shuttling down through Splendorian skies, looked at the chaos in the valley dweller village that lay on a grassy plain fifty meters below her, and saw precisely what Humanity had always hoped to avoid on this planet.

Valley dweller females ran around in a panic trying to gather up their males. It didn't help that valley dweller males were uniformly small, barely sentient, and acted more like children than potential mates. They thought it great sport to elude their females' grasp and run around the village. D'jirar's pleas as she stood on a large boulder waving her arms and calling for calm went unheard, especially given the presence of a dozen or more tall and strangely shaped Humans who could not speak to beings who had no datalinks.

Those Humans had arrived with D'jirar in large evacuation shuttles, one from the *Nivara,* the other two from the *Erasmus.* The evacuation of D'jirar's home village had been postponed; they had to take this settlement out of harm's way instead.

The Humans' arrival must have been something to see for beings who had no idea other stars bore life. So far, the Unity personnel were standing on the sidelines, but soon they'd have to move in and start placing villagers aboard shuttles whether those villagers wanted to go or not.

Chanda couldn't even know if these natives were in danger from the Sobrenians. They were simply the closest settlement to the previous strike. She asked the shuttle pilot to drop her off quickly. The shuttle's screeching gravitics and the clouds of dust it was blowing up could only add to the confusion.

Chanda jumped from the shuttle's airlock, then held her ears against the noise of the craft's ascent and squinted against the dust. Chanda wiped her face with one hand and started toward D'jirar. Some valley dweller females ran at the sight of her, others snatched up wayward males and retreated into their huts.

A tiny tributary of lava flow from a nearby volcano fed village furnaces. Chanda passed untended furnaces and their bellows, and piles of unfinished knives and spears. It was work Chanda knew D'jirar had performed as a youngster.

Now D'jirar was an ambassador of sorts to starfaring Humanity. And to other valley dwellers when it came to this forced evacuation.

As Chanda approached, D'jirar jumped down from the boulder and strode across the hard ground. She said, "We are trying to take these people from their homes for reasons they cannot understand. The very sight of Humans and their craft frightens them. They have never met me and do not know if they should trust me."

Chanda waved an arm to encompass the whole village. "Would you rather they all stay here and die?"

"You know I would not."

"Then we have to do this, whether we like it or not."

"The Unity cannot provide more assistance?"

"I've asked for more starcraft and shuttles to help with the evacuation effort. It'll take several days for the Unity to receive my message."

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"We thought we could trust Humans. Mike said we should trust you."

Chanda frowned. Mike Christopher was the chief contact officer aboard the exploratory craft *Asaph Hall,* which had made first contact eight years earlier. His plan to save both Splendorian species had been a daring one. He couldn't find another planet capable of supporting both the valley dwellers and highlanders in their unique ecological niches, so he wanted to move them to separate worlds. Each species would have to learn to live without the other for several generations until the danger from the supernova passed and they could return to their homeworld.

Unless, of course, the Sobrenians made that world unfit to receive them again.

Mike Christopher had made the plans, the Unity had accepted them, and now it was up to others to carry them out. Mike and the *Asaph Hall* were gone, the *Erasmus* could only do so much, and the main responsibility had fallen upon Chanda. "I'm sorry," she said, "but things have changed since Mike made those promises. This is not the first place Sobrenians have made trouble for Humanity, and we don't want to get into a war with them."

"This . . . war . . . is the very large fight you've spoken of?"

Chanda remembered that "war" was a word that the datalink Humans had implanted into D'jirar did not translate. "Yes. That's what it is. Imagine the Sobrenians' testing happening all across Splendor. That is a war."

D'jirar's tail swept the dirt twice, then nearly curled into a knot. "Then Humanity will not fight the Sobrenians? To avoid this 'war'?"

The wind changed, Chanda caught a whiff of harsh air from the lava flow, and she coughed. "Your people are supposed to be leaving the planet anyway. And Splendor itself will die before a century passes. I'm sorry, D'jirar."

"Then how will I judge what Humans tell me in the future? When will you change your intentions again?"

"I only know we have to save the people in this village, and we don't know how long we have before the next wave of disruptors arrives."

"You speak too truthfully, Chanda. I did not believe that was a duty of an 'ambassador.'"

Chanda heard the word "ambassador" in D'jirar's own sibilant speech as well as the datalink translation; it was another word unknown to valley dwellers before Humanity arrived. She mustered a hopeful smile and said, "This ambassador considers it her duty sometimes. In fact, I like to tell my staff that the greatest honor I can give them is to speak plainly to them."

"I wonder," D'jirar said, "if they always appreciate that honor."

Chanda's smile blossomed into a grin. "Not every time, I'll admit. We'd better get moving. We've got a lot of scared villagers to get aboard these shuttles."

It wasn't easy. As the Humans remained at the edge of the village, D'jirar tried her best to explain about beings from the stars, and why they needed to leave the area immediately. Little of her story made sense to most of the villagers, and only about a dozen out of a population of a hundred or so lined up to enter the shuttles.

About half the remaining villagers, all young females, stood their ground outside their individual huts. Several grabbed spears, which were, after all, their stock in trade. Chanda told the officer in charge of the Unity forces, a Lieutenant Tiernan, "We'll try to convince them to drop their weapons. D'jirar will talk first. If that doesn't work, you'll draw stunners. On the *lowest* setting, and try not to let your beams play over any children or males. Even a stunner blast could seriously hurt them, and they're both too small to hinder us."

"Agreed, Ambassador." Chanda couldn't help but notice the lieutenant's subtlety in agreeing independently on her rec-

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ommended course of action rather than seeming to take orders from a mere civilian.

Chanda turned to D'jirar. "Ready?"

"Yes," she replied, and stepped toward the nearest concentration of villagers. As Chanda watched D'jirar advance, her thoughts veered toward Domerlan and focused intensely on her anger toward him for forcing her into such desperate measures. When other Splendorians, valley dwellers and highlanders alike, learned of this incident, it could poison the trust that Mike Christopher, and after him the crew of the *Erasmus,* had built up over the last eight years between Humanity and Splendorians.

And why shouldn't it, she thought. We're about to betray that trust.

Chanda was too far away to hear D'jirar's words to the villagers, but they didn't seem to be helping. Many of them were pointing at the Humans, and waving their spears.

Chanda saw Lieutenant Tiernan's hand rise to rest upon the butt of his stunner. Other security officers followed his lead and stiffened their stance. Clothing rustled, a holster strap unsnapped, someone cleared her throat.

Then a female struck D'jirar with the blunt end of her spear. D'jirar fell to one side as the other females surged forward. Chanda feared D'jirar was about to be trampled. "Fire!"

They didn't, of course, not until Lieutenant Tiernan drew his own stunner and calmly fired into the crowd. Valley dwellers dropped onto the hard ground, most without even a cry or moan. Those who hadn't participated in the charge did enough wailing for those now unconscious.

Chanda ran up to where D'jirar lay. She had to push a couple of limp forms aside to reach her, and was glad to see D'jirar starting to sit up and rub the left side of her wide, green-scaled face. "Are you all right?" Chanda asked.

"I blocked most of the blow with my arm."

Lieutenant Tiernan stepped forward. "I assume, Ambassador, we're to place the ones we've stunned into the shuttles?"

"You assume correctly," Chanda said. "But let's get D'jirar aboard first."

Many males had taken advantage of the confusion to tear themselves away from clutching fingers and run around the village once more, so the process of rounding them up began again, only with fewer females to take care of that chore, and even fewer with the presence of mind to bother.

As Chanda helped D'jirar stand and got her walking toward the nearer shuttle, the valley dweller said, "My pride seems to have taken the harshest blow."

Nine hours later, Chanda and D'jirar stood beneath the stars at the edge of the now-deserted valley dweller village. The *Nivara*'s small shuttle was waiting.

Chanda could feel the remnants of the day's heat rising from the ground. And that *quiet* again—not as pervasive as in the area disruptors had scoured of life, but eerie enough. No pans rattling, no youngsters or males running about, no chattering neighbors.

D'jirar said, "This was a difficult day."

Chanda could only nod. "The first of many, I fear. At least three more villages could be in harm's way." And what of the valley dweller refugees now aboard the starcraft *Erasmus?* Should they take them elsewhere on Splendor and try to find a suitable site to create a new village? Or just take them on to Kardashev System? That's where the Unity wanted them to end up anyway, but it was supposed to be their informed decision, not one imposed literally from on high.

Irrationally, Chanda found herself looking into Splendorian skies, as if she could see the *Erasmus.* The village's inhabitants were crowded aboard that ship now, no doubt frightened and bewildered. They'd learn the truth about the existence of other Galactic species, and about the coming nebula. D'jirar

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had recruited other valley dwellers experienced in that routine.

D'jirar asked, "Are we far enough south to see the nebula?"

Chanda looked around to get her bearings. "Lemme see. That's west," she said, pointing toward the low tree line behind which the sun had set. She swept her arm to the left. "So that's south. Well, I'll be damned. Look just to the right of that tall tree—" All of three and a half meters. "—See that smudge there?"

"It is faint. It resembles a webbing. I can see what appears to be arms reaching out from it."

"Now you've seen the nebula."

"Mike never showed it to me. I wonder if he didn't want to frighten me."

Chanda sighed. She was tired of hearing about Mike as if he'd been a savior, when he'd left things in such a mess. Typical explorer mentality, just like her parents. And she was cleaning the mess up. "Are you frightened?"

"No more than before. And better to look at your enemy plainly. To know her as well you can." D'jirar paused, and Chanda waited her out. Finally, the valley dweller said, "We betrayed these people this day."

"I know."

"They may never fully trust Humanity."

Chanda's throat felt constricted and she knew her voice sounded strained. "I can't say I blame them. And I understand mistrust."

"Is this your 'personal history'?"

"Yes. I'm forty-three subjective years old. But I was born sixty-nine years ago. My parents were explorers. They didn't want to risk my life on their missions, so they didn't take me with them. They kept me in stasis on a Human world. That means I hibernated while they were gone. And they would be gone for years at a time."

"Your people are full of wonders."

Chanda gave D'jirar a sideways grin. "It wasn't so wondrous to live through. I'd wake up as if it was the next day and my parents would have aged years at a time. My friends would be years older, too. I'd be a kid to them. Do you understand?"

"All young ones wish to be older. Until they grow old themselves."

"I see our peoples are alike in that. My parents were killed on one of their exploratory voyages when I was fourteen, at least subjectively. I'd tried to rebel the last time they put me in stasis, but it didn't work. When I woke up, they were dead. Along the way they'd aged about three times as much as I had. It was disconcerting, to say the least." "Disconcerting" was the word Chanda had settled on long ago to reveal some of the effect her parents' actions had had upon her, without revealing *too* much.

"Then you *do* understand betrayal."

Chanda emitted a low cough. "I like to think I do."

"And now you travel as they once did, to help others who have been betrayed."

Not like they did, was Chanda's instant thought. She knew what D'jirar meant, though. "I travel, one place to another, and try to understand."

"Then I must hope that your understanding makes a difference to my people."

Chanda no longer felt any of that residual warmth rising. "We'd better leave. No telling when the disruptors could arrive."

Chanda insisted that D'jirar spend the night aboard the *Nivara.* Barely ninety minutes after they'd lifted from Splendor's surface, she'd gotten the valley dweller settled into guest quarters, then fallen into bed herself and was instantly asleep. Two hours after *that,* the ship's emergency chime awakened her.

Chanda touched behind her left ear to activate her datalink. "Captain Bram? Ambassador Kasmira here."

A starcraft captain in the midst of an emergency isn't one to waste words.

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Captain Bram said, "The Sobrenians have struck again," then cut the connection.

Chanda threw on clothes, then went to D'jirar's quarters just as the confused valley dweller was sticking her head through the doorway. "I was concerned," she said, "but did not know where to go."

"Just stick with me," Chanda said. "It looks like we're going to need each other more then ever."

By the time they reached the *Nivara*'s bridge, Captain Bram had a holo display up next to his captain's chair. It showed the area the disruptor craft had struck. Blinking red dots marked strike areas. So many, Chanda thought, and over such a wide area.

"The first strike was just nine kilometers from the village we evacuated today," Captain Bram said. He often shrouded his feelings behind his dark beard, but Chanda had worked with him long enough to notice his hooded eyes and the way his fingers worked the readout controls just a little too efficiently, as if his fingers were trying to distract him. "Domerlan wasn't lying when he said the *Melareon* wasn't the source of the disruptor craft. They came in on a stardrive jump just outside the atmosphere."

The idea nearly took Chanda's breath. "No wonder they're so eager to develop this technology. Can we fight it?"

Bram shook his head. "Now that we know what to look for, our comp could probably get us into the vicinity before they started their final atmospheric approach. But what do we do once we get there?"

"*Nivara* hasn't the weaponry to destroy them?"

"Not nearly. And their tech's certainly effective over broad areas. Look at the weapons spread. It was stretched over a hundred K, even though it wasn't continuous."

Chanda asked, "Meaning they missed some spots in the middle?"

"Exactly. D'jirar, I'm sorry. Some of the spots they did hit were at the edge of several villages."

D'jirar eased closer to the readout. "More of my people . . . have died?"

Bram exchanged glances with Chanda. To D'jirar he said, "Yes. Dozens, in three villages."

Chanda asked, "Injured?"

Captain Bram's gaze was unyielding. "None." Chanda understood. A disruptor blast either struck you or it didn't. Bram continued: "I've got a team going down there within the hour."

D'jirar turned to Chanda. "You *must* stop this. My people cannot. We do not have your tools, to fly into space and tell the Sobrenians they must stop." D'jirar's reaction reminded Chanda that Splendor and its inhabitants were only eight years removed from knowing a single world and its two intelligent species.

"It gets worse," Captain Bram said. "Chanda, I received your return message from the Unity while you were on the way up here."

Chanda said, "They've refused any more help, haven't they?"

Bram's shoulders slumped. "No more evacuation craft. No military craft available, either."

Chanda shook her head. "They still don't want to get into a fight with the Sobrenians. Just goes to show you, the toughest negotiations are with your own citizens."

"Can't say as I blame them," Bram said. "I like a good scrap as much as anybody, but this technology is beyond anything we have when it comes to destructive capabilities. And if they can make them appear just outside the atmosphere, you don't have much time to react."

"Which makes me wonder why they would use it here, on a world where the Unity would know from the beginning about their new toy."

"Perhaps," D'jirar said, "they wish to frighten you. As they appear to have done."

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Chanda placed a hand on D'jirar's shoulder, which was surprisingly warm to the touch. Valley dwellers were so superficially similar to reptiles it was tough to remember they were really much closer to Earthly mammals. "You've seen what the Sobrenians can do. They could turn those weapons on this ship, or on the *Erasmus*, and we would all die. That wouldn't help your people."

The tip of D'jirar's tail curled into a tight spiral. "Chanda, I have stared down a hungry quicksleep. I survived crossing the Strait of Ancestors while my sister broke through the ice and died. I have helped raise her daughter. I have spent hours digging into a burrower's nest when I was on a trading journey and near death from hunger. When a female shows the proper courage, she succeeds. I must succeed here. *You* must help me."

"I wish it were that simple. To help you, I need more ships and more people, and I can't get them. An ambassador has to convince her homeworld what's really important. Each thinks the other is out of touch. Each sees the other's needs as below their event horizon."

"I'm sorry, Chanda, that last part—"

"Didn't translate, I'm sure. It means if I tell them the most important thing here is to save valley dwellers, they tell me the most important thing is not starting a war with the Sobrenians. I don't have to like their decision, but I have to live with it. And like Captain Bram, I can't even say they're wrong."

"Then please take me down to the planet. To any valley dweller village in danger. I may be able to help you better down there."

"How?"

"By taking a great risk. But I cannot think of that now. I have sacrificed too much already. I told you that when my sister died, I took her daughter U'tarna into my home. I have been working for the good of all my people rather than raising my niece. She will go to Kardashev soon with A'doranon, whom you met. If I am to be separated from her, it must be for a reason."

"Should I go with you? If you have a plan, and there's any way I can help. . . ."

D'jirar stood stock still a moment, which was common for a valley dweller deep in thought. Then she said, "Best I do this on my own. It could be days before the Sobrenians send more disruptors, or it could be moments. My people have no time to waste."

Chanda nodded toward Captain Bram, who said, "I've been keeping a shuttle on standby. You can leave right now."

"I thank you, Captain . . . Ambassador. I hope to see you soon." D'jirar left.

Chanda watched the door to the corridor slide shut behind D'jirar, then said, "I hope she's not planning something foolish."

Bram nodded agreement. He touched a pad and the holo of the latest attack sites faded.

Chanda contacted D'jirar by datalink several times over the next few days. D'jirar wouldn't say what she was up to, only that she was visiting the leaders of three valley dweller villages, each of which was in the likely danger zone, each within about a day's walk of the others.

The *Erasmus*'s captain wanted to get on the way toward the Kardashev system. He had a starcraft full of frightened and angry valley dwellers and saw no reason to linger. His ship's armaments were as limited as the *Nivara*'s, and Chanda agreed that in such circumstances it would be unconscionable to take dozens of civilians into a combat situation. She approved the *Erasmus*'s departure, and within hours Chanda stood next to Captain Bram's command position on the *Nivara*'s bridge and watched as the *Erasmus* boosted toward the outer system where it would enter stardrive. She told Captain Bram, "Now we're completely on our own."

"We've still got D'jirar," Bram said.

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"Any sign of unusual activity down on the planet?"

"Some movement among those villages D'jirar's been visiting. Could be some kind of hunting expedition. Or the beginning of a migration out of the area."

Chanda folded her arms. "She worries me."

"You never know. This is her home. She knows the rules here. Maybe she'll come up with something."

Chanda looked at Bram. "It's the 'something' that has me the most worried."

The next morning Chanda arose, transmitted her standard daily request of Captain Domerlan for another meeting, received her standard answer (none), and went to the *Nivara*'s bridge for her morning update before getting a bite to eat. When she saw Captain Bram and two of his bridge staff huddled over a sensor console, she muttered, "Uh, oh."

At the sound of Chanda's voice, Bram turned his attention toward her. "We may have a problem."

Chanda stepped to the console and looked at the readout. "The population of all three of those valley dweller villages are on the move."

Bram said, "It looks like they're headed for some sort of rendezvous."

"This has to be D'jirar's doing." Chanda touched behind her left ear to activate her datalink. "D'jirar, this is Ambassador Kasmira. What's your status?"

No response. Bram spun around and touched a pad on a comm panel. "We're still getting her signal. Her datalink's intact, and registers as being within living flesh."

"D'jirar, you have to answer me. We know you've got a lot of valley dwellers coming together in one place. If you're thinking Domerlan won't risk killing all of you at once, you're wrong."

Finally, D'jirar's voice came over Chanda's link: "I understand he does not care about our safety. But he does care about the information he seeks. He told us he wanted a widely scattered population of 'presentients.' I have made sure this particular population is no longer so widely scattered."

Bram shook his head when Chanda passed on what D'jirar had said. "We can't know this is a big enough change to make him divert those disruptors."

Chanda passed that comment on to D'jirar, who replied, "I have taken a great risk. Now you must decide. Do you also take such a risk? And what will it be?"

Before Chanda could say anything, Captain Bram said, "She's gotten Domerlan's attention. He's trying to contact us."

Chanda said, "Let's hear him."

Domerlan's wide-set eyes focused the *Melareon* captain's anger on Chanda even over the vidlink monitor next to the sensor console. "I speak with you not-in-person because our previous meeting was cordial, and out of respect for the Unity. Further communication, however, will be face-to-face, and on my starcraft. That is the respect Sobrenians expect of all other Galactic species."

Chanda took a deep breath. "Could I ask your reason for calling?"

"You will return those Splendorians to their respective villages."

In her peripheral vision, Chanda could see Captain Bram rolling his eyes. Chanda had to keep things professional. "Captain Domerlan, the Unity protests the second incident of several days ago in which Splendorians have died. Shuttle down with me to the planetary surface. If you could see what your weapons have done to entire villages, see the grief of the valley dwellers who've lost loved ones—"

"Those villages, and such grief, are not my concerns. I care for my own people. I know you will not risk war to halt these tests. The Unity's lack of commitment to this world shows me that. Tell your Splendorian puppet to restore the previous population distribution. If she

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does not, the frequency of testing will increase, as I warned earlier. I need not speak with you again." The connection snapped off.

Bram didn't try to hide the bitterness in his voice. "I didn't expect any better. He doesn't quite see us as real, does he?"

"He's racist. Typical of his species. And yes, I know how that sounds."

Bram spread his hands wide. "We can't make any more evacuation plans. This ship doesn't have the room. The *Erasmus* is gone. Diplomacy, begging your pardon, hasn't worked."

"It hasn't worked *yet.* Domerlan's right. We're in this mess because of the Unity's lack of commitment. And we can't expect any more help."

"So it's all up to us."

"But something . . . it's what Domerlan said. . . ." The idea was fuzzy, barely formed at first, then came clear as Domerlan's words returned to her. An example of the Unity's lack of commitment.

She knew how to cope with that, from growing up as a child who awoke three or four years or a decade into the future every so often. At age fourteen she'd not asserted herself quickly or forcefully enough, and her parents died while she slept the years away. The lesson she took from that: don't hesitate, and always act on your own needs and values no matter who stands in your way.

That's when it all came together for her. Bram must have seen something in her expression, because his eyes widened. "What is it?" the *Nivara* captain asked.

"We're headed down to the surface."

"I'll alert a shuttle team."

"I don't need the shuttle team. And you're included in the 'we,' Captain Bram. You're about to literally go down with your ship."

Two hours later, after the final preparations had been made, Captain Bram sat in his commander's chair and glared at Chanda. "You sure there's not another way to do this?"

Chanda shrugged. "I'm open to suggestions." She understood Bram's concerns. Just because the *Nivara* was capable of landing on a planet didn't mean it was an easy task.

And no starcraft captain wanted to lose a ship, even temporarily.

Chanda said, "You notice the Sobrenians never responded to the *Erasmus,* but they did, eventually, respond to me when I called as a Unity ambassador."

Captain Bram took a deep breath and looked at his conn officer, Ensign Liana Santos: "Enter reentry protocol. Access the ambassador's station for the landing site."

Santos, her attention split between the controls and the forward screen, made the entry. "Accessing," she said.

"Initiate."

Santos touched a control. "Done."

Splendor grew more quickly in the main viewscreen than Chanda would have expected. She double-checked a holo of their landing site. Flat and barren, which was good. It was near the rendezvous area where the valley dwellers from the three villages, at D'jirar's insistence, were gathering. It was also in the presumed "danger zone," given the pattern of the two previous disruptor attacks.

In all, it took nearly forty minutes to bring the *Nivara* in. Forty minutes of Ensign Santos guiding a sixty-meter-long craft without wings, with minimal physical shielding on its underside, and with seldom-used gravitic fields cushioning the ride for the sake of the starcraft's hull and its Human cargo.

Those fields meant it wasn't a rough ride, but it was a tense one for Chanda as she monitored the aerodynamic loads on the *Nivara*'s frame and kept an eye on their approach to the landing site. Not that the *Nivara*'s bridge crew wasn't taking care of that on their own, but it never hurt to double-check.

Then, finally, touchdown, a time too

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busy to take note of any reaction from the valley dwellers only half a kilometer away. The *Nivara* settled onto the barren plain. Chanda could hear the low crunching sounds of compacting dirt and grinding stone through the ship's hull as the *Nivara*'s landing struts settled in.

"Here we are," Chanda said. "My first embassy assignment. I've always specialized in field work."

Captain Bram said with a wry smile, "I'd just as soon have passed on the honor."

Chanda couldn't help but smile at that, but then came another flurry of activity, and she watched as bridge crew made a quick internal scan to make sure the *Nivara*'s hull integrity was sound, that the craft wasn't suffering from any major coolant leaks, and that the gravitic generators were cycling down properly. Within fifteen minutes Captain Bram pronounced the *Nivara* secure. He told Chanda, "We're ready to lift again within five minutes if we have to."

"Let's hope we don't have to," Chanda said. Over her datalink she asked, "D'jirar? Are you on the way?" She'd notified the valley dweller of her intentions and requested her presence as soon as the *Nivara* landed.

"Approaching the starboard airlock," came the response. Bram ordered the starcraft's embarkation tube extended and within moments D'jirar joined them on the bridge.

That's when Chanda told D'jirar, "I have a formality to perform."

D'jirar's tail curled almost imperceptibly. "Ask what you must."

"It's very simple. Request our presence on Splendor's surface as an official embassy of the Earth Unity."

"Very well. I request your presence."

"Good. That, I think, makes our presence here legal in the eyes of the Unity."

Captain Bram spoke up. "You *think?*"

"*Shh.*" To D'jirar: "And . . . you have to agree to become the Splendorian ambassador to the Earth."

D'jirar's wide, green-scaled face froze in place. "I wanted to join the people from my village when they leave for Kardashev. If I agree to do this—"

Chanda told her, "If you agree to this, you'll be saving their lives. And you wanted to be a spacer, someday, too. Someday turns out to be sooner than you wished."

"Then, I agree."

"Thank you. I'm sending an urgent message to Earth Unity Diplomatic Headquarters." She pressed a subspace comm control. "I'm letting them know the *Nivara* is now the Earth Unity embassy to the Splendorian people. And that procedures to retrofit it as a surface base are ongoing."

Bram was looking over her shoulder. "In the clear, so Domerlan gets the message, I see. But what's this about retrofits as a surface base? I haven't even retracted the landing struts. And I hadn't intended to. We'd never get off the surface if we did."

"My mama always said it's easier to ask forgiveness than permission. And I just said the retrofits were ongoing. I didn't say how fast they were proceeding. Or if we might change our mind later."

"Good. I've no interest in being a groundling any longer than I have to. Or a target. So what now?"

"Something both diplomats and the military are used to. Waiting."

It didn't take long. Twenty minutes after Chanda's announcement of the Unity's newest embassy, she was nearly dozing in her chair on the *Nivara*'s bridge. Or was it the embassy's lobby now? That's when Ensign Santos reported: "Incoming disruptors."

Chanda sat up straight. "That's not how this was supposed to work."

Bram went to Santos' side, double-checking the sensor readout. "She's right. Fifteen stardrive signatures, small ones. Small enough to drop out near a planetary mass safely."

Santos said, "Estimated target, one and a half K southwest of our position."

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She looked at Chanda. "Dozens of valley dwellers in that area."

Chanda checked her own set of sensors. "They're about twelve thousand kilometers out. Closing at just over twenty-seven K a second."

Bram finished the calculations first. "They'll be here in seven and a half minutes."

Santos said, "Incoming from the *Melareon*."

Chanda glanced at Captain Bram, who rubbed his dark beard. "You'd better answer. This is an embassy now."

Chanda shrugged in resignation. To Santos, she said, "Let's hear what he has to say."

The Sobrenian's image appeared next to Bram's position. His arms were folded within the fabric of his multi-colored robes. "This is my final exception to not-in-person. Why do you place yourself in the path of our disruptors?"

"This is our embassy to Splendor, Captain. You were correct. Establishing it was overdue, and we have placed it here, admittedly on an emergency basis. May I ask that these disruptors be diverted from their path?"

"The disruptors are under the homeworld's control. The *Melareon* is only an observer craft."

Dammit. If Domerlan was telling the truth, in just under seven minutes, Earth's newest embassy would become its shortest-lived. Chanda said, "Captain Domerlan, I'm going to give you what I call my greatest honor. Do you realize the consequences of firing upon the territory of a sovereign planet?"

Domerlan said, "It is enough that you will die if you do not lift your craft."

Chanda slammed her fist on the sensor console. "This could precipitate a war with the Unity!"

"I do not care about the Unity. The probes were launched before your embassy was established. Why do other species act as if their perceptions matter, as if they are sentient? You would die for these beings? They who are not yourselves? You have time to lift before the probes strike."

Behind her, Captain Bram said, "He's right. Six and a half minutes. Just enough time to power up and get the hell out of here."

Chanda turned to snap at Bram: "The villagers can't get the hell out. Domerlan, you have to have some way to divert those probes."

"We have no need to divert them."

Which begged the question as to whether *Melareon could* divert them. "Captain Bram, retract the landing struts."

Chanda had never seen Bram's mouth gape open before. He knew what it would mean to comply. *Nivara*'s hull would settle down onto the Splendorian surface and any chance to escape would be lost. "I can't—"

"You can, and you will. Like you said, this is the embassy now. That puts me in charge. *Retract the struts.*"

For a moment, Chanda thought he would defy her. Instead, Bram nodded at Ensign Santos and she began the procedure. Five-forty left. Domerlan's image looked on impassively.

No internal gravitic fields now to cancel out the *Nivara*'s movements. The starcraft shuddered beneath Chanda's feet, just strongly enough that she had to grab her console and hold on tight. At just under five minutes, the ship finished settling to the ground.

Domerlan's image disappeared.

Chanda told Santos, "Get him back!"

Santos worked the comm, but shook her head. "Contact broken at their end."

Bram said, "Four and a half minutes."

Santos reported, "Disruptors sixty-five hundred K out."

D'jirar said, "I am sorry everyone has to die for my people."

Four-twenty.

Captain Bram said, "Bring the gravitics down. All the way down. I want them cold as we can get them by the time those probes strike. Domerlan has to be certain we can't lift."

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"Working," Santos said.

Chanda told Bram, "Can we launch a recorder drone? Have it hover and start transmitting in the open on all Unity channels?"

Bram nodded, touched control pads, and within moments that was done, too.

Just under three minutes. Did the disruptor probes have a point of no return? If so, had they already passed it?

"Well, Chanda," Captain Bram said, "I guess we're about to learn if you're the genius or the goat."

Chanda said, "Please. I could at least be a martyr." Then the humor faded from thought and the enormity of what was about to happen flowed into Chanda's awareness. "I'm sorry I got you into this. You and your crew. You've been very brave."

Bram rubbed his beard and seemed to take a long time composing his answer. "We wouldn't have followed just anybody down here."

Santos spoke, and Chanda heard the catch in her voice. "The disruptors are boosting. They're headed out of atmosphere." No one spoke, just waited until moments later when Santos reported, "The probes have made a stardrive jump. They're gone. And the *Melareon*'s boosting out of orbit."

Chanda said, "Try to make contact again." She didn't want Domerlan to leave without a last word with him. She watched Santos work.

"Here comes something," Santos said. Then her features went from hopeful to downcast in an instant. "Contact refused."

Chanda sighed. "That's plain enough, I guess."

Bram said, "Just be glad they're leaving."

"I am. But I have to wonder whether I've made an enemy in Domerlan."

D'jirar said, "If I am to be an ambassador, perhaps I need to give you my own greatest honor. You have no time for wondering. The Unity has an embassy on Splendor, and you have responsibilities."

Chanda said, "You're right. Let's get started."

Two weeks later, Chanda was once again gathering her jacket's collar against Splendorian chill, once again standing in D'jirar's village, watching her say goodbye to U'tarna and A'doranon. Only this time it was D'jirar who was staying put and U'tarna and A'doranon who were going on a journey, one much farther than D'jirar had ever attempted.

Around them, the village's population also stood, their few possessions wrapped in rough cloth at their feet or slung over their shoulders. Their conversation was muted, expectant, nearly reverent.

The *Erasmus* would boost with all the population of D'jirar's village aboard before the day was done. A Unity light cruiser, the *Sergeant Jelal,* was to pick D'jirar up within the week. It would also take the *Nivara*'s crew off Splendor—they were *not* ready to become groundlings!—and deliver Chanda's embassy staff.

Chanda said to A'doranon, "The *Erasmus* is sending its shuttles down right now. You'll be leaving soon."

A'doranon translated for U'tarna, who began jumping up and down and chattering incessantly. Chanda didn't need a translation to recognize the valley dweller equivalent of "Whoopee!"

D'jirar said, "She has been very eager to leave. So eager, I fear she may not miss me for long once she arrives on Kardashev."

"She will," Chanda said. "She may not realize it herself at first, but she will. Everything's happening so fast. You and U'tarna and A'doranon are becoming spacers of sorts, just when I've found myself turned into a groundling for awhile." The Unity had quickly approved maintaining the *Nivara* as its embassy on Splendor, and making Chanda Earth's first ambassador there.

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D'jirar asked, "Will Earth welcome me?"

Chanda couldn't lie to her friend. "Most you meet will welcome you. Some won't. It may be difficult. You have to keep the needs of your own people in mind. Remember you're working for them. The Sobrenians have told the Unity if you or I gave up our positions as ambassadors from our respective planets, they would consider our actions from the beginning a sham, and would return here for more testing."

"Then I will see myself as being on a trading journey. The longest of my life, and the farthest away, but I hope the most rewarding."

A'doranon asked, "And what of you, Chanda? You hope you will enjoy your own change? You are used to traveling to many worlds, are you not?"

"This will be new for me. I'm used to being in new places, and meeting new people all the time."

A'doranon said, "Your parents separated themselves from you. And were always different when you woke up. And they died too early. It wasn't fair."

"But I survived. I learned what little I know about life on my own. But not everything. It's an odd thing for an ambassador to say, but I've never been able to trust anyone, not really. It's because of how my parents treated me. I finally figured out I couldn't even trust myself. That's why I never stayed in one place. I'm as bad as any explorer, just flitting to one place after another, never committing. Now I'm ready to commit to Splendor. At least for awhile."

Two shuttles from the *Erasmus* screamed overhead, then circled to pick their landing spots.

D'jirar said, "You will discover more that is new, even in this single place, than you can imagine. You already know more than Captain Domerlan. He believed his species' strength could change an entire world and its peoples to suit his needs. You possess a different kind of strength, which tells you that you must change yourself. And you will do so successfully, I know. This is nothing mysterious. It is as I told you before. When a female shows the proper courage, she succeeds."

Chanda smiled, then led the way as she and D'jirar escorted A'doranon, a happily skipping, tail-flipping U'tarna, and the rest of the population of D'jirar's village toward the waiting shuttles.■

(Editor's Note: This story is a sequel to "A Glimpse of Splendor," [February 2000].)

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Probability Zero

How I Won the Lottery, Broke the Time Barrier (or is that "Broke the Time Barrier, Won the Lottery"), and Still Wound Up Broke

Ian Randal Strock

I'm sitting at my desk at home reading *Physics Review Letters* (you read your romantic thrillers, I'll read mine), and I hear a loud pop, followed by the sound of wind rushing past my right ear.

A voice sort of like mine, says "Listen carefully. I'm from your future. For me, today is March 16, 2026. For you, it's March 16, 1999. Tomorrow's Lotto drawing is for forty-five million dollars. The winning numbers will be 17, 19, 30, 32, 42, and 51."

I decide to play along. "Why are you telling me?" But I hedge my bet—I always read with a pen and paper, so I write down the numbers.

"Because you're me, and this is your destiny."

The rushing sound stops with a loud pop.

What the hell—I'm broke. I know I'm capable of great things, if I could only get far enough ahead, financially, to get out of my dead-end job, but being an introverted lab assistant at a minor university is not a high-growth position. I buy a ticket. *It came to me in a dream* will be as good an explanation as any other.

I win. $45,000,000, payable in twenty-six annual installments. Call it $800,000 a year, after taxes.

That's enough to go into full-time research. . . . I'm no fool—if I'm going to communicate with myself in the past, I'm going to have to build a time machine. At the same time, it's also not something eager young lab assistants talk seriously about—better to do the research in secret.

I go from nearly broke to living like a pauper with a hobby that costs three quarters of a million dollars a year. Books, studying, conferences, research, and increasingly more expensive equipment.

Keeping the project a secret isn't too hard—I've always kept to myself—but it does mean post office boxes for my subscriptions and mail orders, and attending those conferences with different names—always as an anonymous attendee, never as a participant.

* * *

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Ten years of research, and I'm making some real progress. For instance, I now know it will be much easier to build a machine that only needs to traverse the time barrier, without having to move in space. That means my best bet is to build it right here, in the very bedroom/office in which I received the message.

Well, my landlord decides to sell the building out from under me, and suddenly, I'm about to lose the spacial congruence that seems necessary to success.

I find myself a lawyer, and get him to negotiate with the landlord.

The negotiations go well: to cover the mortgage, the bank will take my next six annual Lotto payments. I convince them to leave me living expense money, and they make it almost all of the next eight payments. And, of course, I'll have to hire a superintendent.

I can continue my study undisturbed, but physical research will have to wait until I can again afford new equipment. It's amazing how you forget how much you need $750,000 a year until you don't have it.

Things are finally starting to look plausible. The energy source will cost me two million dollars—three years' payments—and with that much juice flowing through it, the equipment will destroy itself after one use. But it can be done.

Everything's ready, but for the power. I'm forced back to inactivity, to save my last three payments to buy the power source, but I persevere.

Finally, the big day. The machine is ready to open a small, short-duration, twenty-seven-year-long artificial wormhole. I drink some water to make sure my voice is clear, sit next to the aperture, and power up.

There are a few bangs and pops, something that looks like lightning, and an infinitely long tunnel of fog appears in the aperture.

Remembering those twenty-seven-year-old prophetic words, I say "Listen carefully. I'm from your future. For me, today is March sixteenth, 2026. For you, it's March sixteenth, 1999. Tomorrow's Lotto drawing is for forty-five million dollars. The winning numbers will be 17, 19, 30, 32, 42, and 51."

A younger, far-away (and long-ago) voice comes back to me: "Why are you telling me?"

I guess I was a bit of a skeptic back then. "Because you're me, and this is your destiny." I'm glad I've been able to remember the conversation all these years—I don't even want to think about the paradox of saying something different.

The fog flows away as the bangs get louder, and the lightning dimmer. Then there's a final loud bang and blackness.

The next thing I know, I'm lying against the far wall, behind an overturned lab bench. The only light comes from holes in the wall . . . and the dying flames of my equipment under the sprinkler system.

The paramedics check me out and declare me fit. The fire department checks my building out and condemns it.

Now what? I've created, used, and destroyed a single-use time machine. I've spent twenty-seven years and my entire fortune to build and use it, ensuring that I'll have won that Lotto jackpot. The greatest scientific achievement of generations, and if I talk about it, the only thing I'll get is ridicule. "You expect me to believe that you won forty-five million dollars, and then spent it all to ensure that you'd win it, and incidentally, destroyed the proof that you built a time machine? Yeah, right. You're only trying to justify losing an entire fortune."

I wonder if my old lab assistant position is still available.■

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Sometimes old ideas find very new applications. . . .

ALL MINE

Laurence M. Janifer

I don't think I would have passed Ulla for colonization, but it's a judgment call. The planet was dangerous, but all planets are dangerous, and so are all the other things in the Universe. There are no safe objects, and a planet is a collection of a great number of objects.

It isn't the danger that would have made me write the place up as unfit for colonization—it's the nature of the danger. Some things—mosquitoes, tigers, earthquakes—the human race can live with, and some things—poisonous atmospheres, unfriendly intelligent races, extremely prevalent volcanic action—it damn well can't. Ulla, as I say, was a judgment call.

It was, of course, the Wocks. Wocks have become cute little decorations on a good many planets by now—artificial Wocks, made of fake fur or hair or whatever it is they're covered with, and all nicely inflated so they'll bounce around your rooms looking like furry (or hairy) basketballs, somehow painted bright orange. Just like the real thing. The more expensive models even make the sound the damn plants are named after, a little wock every time they touch a surface.

But—if you happen to have one or two around your home (and the people who buy fake Wocks never do seem to buy just one each), don't trot it out if a visitor from Ulla happens along. He'll shoot it first, and apologize (if at all) later; and if he hasn't got a gun he'll use a large knife, a blunt instrument, or, in severe cases, your sofa or piano to "kill" the harmless, orange little bouncer.

They are plants, by the way, and if the idea of a plant without any roots at all, and no specific location surprises you, you don't know too much even about plants on old Earth; see any fact piece on tumbleweeds, for instance.

Understand me—the imitation or souvenir Wock is an entirely harmless creature, if you discount the nausea that comes from overcutesiness; and the real,

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or Ulla, Wock is harmless, too—six times in ten. The other four times, it's not only poisonous, but poisonous with, so to speak, great enthusiasm; touch one and you keel over, and death occurs within forty seconds. There is some kind of nerve toxin, attractive and nutritive to a species of small bird on Ulla (well, more like a bat, actually, but a bat the size of a small leaf), which zaps humans just as if Ulla were Earth itself and the Wocks were bright-orange spiny jellyfish.

All right: make pets of the harmless Wocks, and either avoid the poisonous ones, or shoot them on sight. Problem solved.

Only—how do you tell one kind from the other? The birds-or-bats-or-ambulant-leaves manage it—the harmless Wocks attract an entirely different species of flying thing. And you can manage it, too, unless you have a really bad cold; the harmless Wocks don't have much of an odor, and the poisonous ones have a smell that is a combination of roses and something ammoniac. The smell is the only way to tell them apart, short of dissection—and, as touching a Wock means instant death, if it's the wrong Wock, and you can't be wearing gloves all the time, dissection is not an everyday option.

All right again. Make pets of the harmless Wocks, shoot or avoid the poisonous ones, and if you have a cold stay indoors with the doors and windows shut, so the Wocks can't bounce through and threaten you. Problem solved, again.

I am forced to inform you, at this point, that (like the fellow who remains calm when all about him are panicked) you don't understand the situation. The Wock, though it seems about as intelligent as your average plant anywhere, seems to have what looks like a highly developed bump of curiosity. It likes to get into things, it likes to find out what's happening in interesting places—and it is very likely to bounce up to your house and stay there, quivering a little in the breeze, until you come out. Then it bounces over to say hello, and (if it's the wrong kind of Wock) you die. You don't know about the Wock till you open a door or a window—no smell cue till then—and once you do it's probably too late. The damned things bounce very rapidly, and very well.

Some Wocks are Boojums, if you'll excuse the Classical allusion, and you don't have to hunt them—*they* like hunting *you*.

So you shoot every Wock you see, killing six in ten harmless ones to avoid the four in ten that kill you.

This seems to be what the Survivor who did pass the planet for colonization thought would happen. His name is Bruno Carr, and he is barely competent (below barely competent there are no Survivors among the living), and he spent the required Standard year on Ulla, managed somehow not to get killed either by the Wocks or by the thousand other natural shocks any new planet has in store, and sent in a pass report—and went away. From that point on there were no Wocks in his life; but there are plenty in the lives of the Ullans, and shooting them all would (a) be a Hell of a job—like killing every dandelion on Earth, if dandelions could bounce rapidly around at will—and (b) upset the planetary ecology quite some, as the Ancients used to say. It is not, in other words, an option.

But calling Bruno Carr back for consultation *was* an option, and the Ullans picked it. Carr's reply was perfectly legal, and completely wrong: "Not my table, sorry." He'd done his job, he was going off to do some other job, no time to go back and do the damn job right.

Well, the death of hundreds, if not thousands, of colonists on a colonization-approved planet is bad for business, the way the Comity sees it; so Colonization looked around for a handy victim to send out for repairs to Ulla, so to speak. The project, they told me, was all mine.

* * *

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The colonists were living inside high barbed-wire fencing. I don't mean that each house was fenced—I mean that the whole area colonized had been fenced—or most of it had. There were gaps, and the gaps had been filled with sandbags, bits of wall, chairs, anything that might provide a barrier while more barbed-wire was either ordered in or made on the spot.

This is not only a shame to see, it's a failure of colonization. If colonists require fencing-off from the planet they're on, they're not colonists, they're visitors. They have to be able to go out and prove new land, settle new places—they have to be more than one huddle of humans in one spot on a hostile planet, or the place hasn't been colonized, and can't grow; you run out of room too damn fast.

Yes, there are places settled only under domes—Mars Dome is the oldest example—but those places haven't been colonized, either; they're outposts, for research or other arcane purposes. If you can't wander the planet—with due regard for the planet's dangers, just as on the old Original—you aren't making a home for humans.

I'll skip over the initial meetings with the town mayor—the settlement was called a town, but the right name for it was "fort"—who was a nice, bewildered fellow named Hooper Vass. Vass knew there had to be a solution to the little problem of the Wocks—he had a touching faith in Colonization, and was sure they'd never have sent people out into dangers as omnipresent as the Wocks were, without some sort of response possible—but he was wondering, more and more as time went on, why somebody hadn't told him what the solution was.

"We try," he said one afternoon, in the town offices—one room in a building that was mostly a hay and feed store. Ulla had cattle, and the cattle were just a little cramped by the fencing; the settlement area was larger than the town itself, but not large enough, not really. "We go out—in what amounts to war parties, Knave. Small war parties—the more people around, the more the Wocks seem to want to get to them. Maybe it's body heat, or a moving mass—something—but the damn things are everywhere."

I nodded. "There are a lot of them," I said mildly.

There weren't a million, not in the immediate vicinity—but there were anything up to several thousand in the area around the barbed-wire fencing. It was hard to get an accurate count—try counting bouncing basketballs, when they exist by the hundred or the thousand and keep moving more or less all the damn time—but there were enough to pose an obvious, sizable, and constant threat.

"There weren't this many, the first month or so," he said. "But they—gathered, kind of. Curious, or whatever it is they are—people attract 'em, and a whole town full of people—well, they keep trying to bounce through the fencing—or over it, you know." He sighed. "They can't manage that, not yet—but my God, Knave, maybe one will come along, bounce just a little higher. And suppose it's the poison kind?"

That was part of the problem, of course. The war parties were another part. "You do go out?" I asked.

"Exploring," he said. "It's—well, my God, we call it exploring, but it's a game, that's all it is. We tell ourselves we're charting land, we're finding things out—but what good does it do? Three people go out, one to do the looking and two to watch for Wocks, and they come back with charts and facts—and what use is any of it? We haven't enough fencing for the settlement—town and field—and you can't fence in the whole planet section by section, now, can you?" He brushed at his thinning blond hair and shook his head sadly. "There has to be an answer," he said.

"Of course there does," I said sooth-

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ingly. But I was damned if I knew what one was.

I'd had a few days to get facts on the ground, so to speak, and do some thinking. The problem was simple—you could avoid a Wock if you knew it was there—more or less. Not with certainty, but with fair success; the war parties on Ulla had lost a man or two, but not many. But you had to be looking pretty well all the time—bouncing Wocks come at you very fast, and from all sorts of angles—and that limited the amount of anything else you could do.

And if you didn't see them coming—if (for instance) they were outside your house, just waiting for one of those interesting alien humans to come out and get helloed—you had four chances in ten of being dead right then and there

Not inside the town very much, not yet—though Mayor Vass was right, and a better-bouncing Wock might come along any time—anything develops with practice. But the town couldn't stay behind barbed wire forever, even if it got enough barbed wire.

They weren't curious, of course—it takes having a brain to get curious, they tell me, though what it takes is a mind, and how that hooks into the brain nobody knows—but something about humans attracted the damn plants—body heat, as Vass suggested, or sound, or any one of a thousand things. It was going to be possible to find out what the attraction was, and (maybe) build things that would either guard against it, or attract the Wocks more strongly than humans did, so humans could go about the colonization business while the Wocks bounced around the new attractors.

That would take research, luck and ten to twenty years, minimum—none of which were available on Ulla. In ten years or less the colony would be packed up and abandoned, a colony that hadn't worked out.

And maybe that was how it would have to be. But just maybe, there was an answer right here and now.

I'd assured the mayor there was one, because it seemed the kindly thing to do. But all the ideas I had, had one thing in common: they wouldn't work.

There were lots of things that would poison a Wock—some autopsies had been done on naturally-dead Wocks found around the town, Wocks not being immortal (it was one of their good points)—under fully antiseptic conditions, with gloves, masks and a good deal of caution. Theory suggested a couple of things that could be made with materials available on Ulla.

So, before you leave your house, you spray the outside with the poison—and you carry a can of spray around with you at all times.

This sounded awfully good for about three minutes, until I got some more explanations. It seems no poison easily available worked anything like as quickly on the Wocks as their poison (if they were poison Wocks) worked on humans; Wock death was posited to occur in about an hour, and during that hour anything from convulsive movements of the damn plants to a stray gust of wind could bring the Wock into contact with you.

So you jungle up in your houses, infect the entire planetary atmosphere with a Wock-poison, and . . .

No. For about twelve obvious reasons.

Item: have everybody walk around in protective suits—all the time—while shooting or otherwise disposing of Wocks.

Well, a colony living in protective suits for an indefinite time (finally eliminating Wocks, as I say, is not a really thinkable option) is, once again, not a colony but a group of tourists. No.

Item: equip every colonist with a wide-angle flamethrower, which . . .

Well, flamethrower manufacture is neither simple nor really inexpensive, sorry. The sheer cost was more than the colony could afford, not by a little but by orders of magnitude. If some public-spirited rich person were to provide

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Ulla with as many wide-angle flamethrowers as needed (plus one each for every newborn colonist as soon as dependably ambulant), for the next forty years . . .

Well, maybe. All we needed, at that point, was a public-spirited billionaire who had no better charitable drain on his, or her, income.

Item . . . well, there were a lot of much sillier ideas. (Find a noise that frightens Wocks away, and play it all the time, where humans were?) Some of them were mine, and some of them were the kind of thing a desperate colony develops on its own, after sufficient frustration.

One idea occurred to me after a while. Windows pass a lot of sensory data, but they don't pass smell. If a type of glassex could be developed that was permeable to odor, then you'd know if a Wock were waiting for you outside. Choice of one: stay indoors, or spray a little poison, wait an hour or so and *then* go outdoors.

Unfortunately, there is no work currently going on to make glassex, or any transparent material (sheet plastics, say), permeable to odor.

Or (I suggested) seed the ground of the town itself with poison. Every time a Wock touched down, he'd die; this would clear the town, mostly, and the few remaining Wocks who might bounce in would be no more than a natural hazard . . .

All right: seed the fields too? This required finding something (a) poisonous to Wocks and (b) non-poisonous to crops, animals, and humans. There is no such something, sorry.

It would have been a fascinating problem for a study course somewhere, with students sitting comfortably in a lecture-hall and brainstorming ideas. Unfortunately, we were not in a lecture-hall.

So I talked to the colonists, one or two at a time. Maybe there was a missing fact somewhere; maybe there was something I'd overlooked. You never do know.

Hooper Vass introduced me around, and everybody had a hopeful word for me, and another sort of word for Bruno Carr, who'd left them in their Wock-filled lurch. I talked to cattlemen, agricultural experts, plain farmers, housekeeping types, and one or two small children, to no effect at all.

Then I ran into the town madman, a lanky, unkempt-looking fellow named Roebuck Witherspoon. Roebuck didn't farm, and he kept no cattle (he'd started as a farmer, and given it up when the Great Illumination, as he called it, hit him); he was nothing like an agricultural expert, and what housekeeping he did, according to report—I never did see his place; we met in my room, which had been vacated by a single townsman for the length of my stay—was minimal.

What he was, was a madman. More or less by profession.

He didn't call himself that, of course—and most of the Ullans were too polite to use the word in his presence or near it. What he called himself was a Mining Engineer.

Whether he'd ever had any training to fit that job description, I cannot say. But he knew all about it—what a miner did, he told me earnestly, was dig holes in the ground.

"Gems," he said with a weird crack in his forty-year-old voice. "Diamonds, emeralds, God knows what. Maybe other stuff—coal. Oil. Treasures."

"Well," I said, "surveying—"

"Surveying is a waste of time," he said. "The stuff could be anywhere. Right under your feet. Look at what they find on Earth, every day."

On Earth, archaeologists are still digging up the results of the Clean Slate War, as well as even more ancient artifacts. On Ulla—

"Burial sites," this maniac told me. "Ancient native burial sites. Anywhere. Right under—"

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"My feet," I said, looking down at the nice plastic floor of my temporary home. "I know. But as for natives—"

"You never know," Roebuck told me. "You can't say this Carr fellow was any good at his job. You can't say that."

I couldn't say it.

"See?" Roebuck said. "Treasures. Gems, maybe. Diamonds. Gold, even. People find gold anywhere. Rivers, or you just dig a hole."

As I said, a madman. And at the time I had only one reaction: How did Roebuck Witherspoon stay alive? If he dug a hole, or branched out to pan a river somewhere, and actually found gold or gems or oil, the question would be answered; but the idea of a rich Roebuck W. didn't sound altogether likely, and he didn't seem to do anything else; he spent his time dreaming of the holes he was going to dig when the Wocks weren't quite so much of a threat.

Hooper Vass solved that little problem for me. "Well, we all contribute," he said, a little shamefacedly. "He was a fair hand with cattle, once, you know."

"He was?"

"But the Wocks—well, they got two of his best friends. That was in the early days—" For me, Ulla was still in its early days, but I let the difference in perspective go by unremarked "—and it sort of drove him a little batty. He sat around—well, he didn't do much *but* sit around for a couple of weeks, and then he started all this talk about mining. Or anyhow digging holes."

"And now the town—"

"Keeps him alive," Vass said. "Tragedy, really; he was a fair hand. You've got to do something, Knave—or the ones that don't die, we'll all be as crazy as poor Roebuck is."

When you looked at it, the Ullans were suffering from the strangest kind of cabin fever I've ever run across; they had the town, but they couldn't leave it, and it was getting to them almost as much as the occasional Wock poisoning—until and unless the fencing was completed, of course, a few Wocks still bounced in.

And there wasn't an answer in sight: if the fencing did get completed, it wasn't a solution, it was a surrender.

It took me a day and a half to realize that Roebuck Witherspoon, the town madman, had given me the answer to it all.

I was on Ulla for nearly three months, and the last week or so was a time of celebration. The colonists were like kids who'd been let out of school—they wandered fields and dens for the sheer pleasure of stretching their legs—in a way, for the sheer pleasure of setting foot on a strange planet, the whole reason they'd come to Ulla in the first place.

Every colonist—man, woman, or child—now had a new pet, in a small mesh cage where mesh was available, or in a plastic or glassex cage with air-holes poked into it—both so the little bird-or-bat that liked the poison Wocks could breathe, and so that it could smell its favorite plant. The things had a fine sense of smell, and could tell you a Wock was approaching before the thing bounced anywhere near you.

Every colonist also carried a beamer—beamers being standard supply for new colonies these days, and exactly the weapon I'd have chosen in any case: a slug gun, for instance, splatters something like a Wock when it connects, and nobody wants splatters of poison Wock sailing around.

Catching the little flying things wasn't hard—nets were also in long supply. And as they ate Wock seeds, beamers were stopped down just enough so that one shot would kill and char the Wock, and leave the interior seeds untouched The flying pets, or warning signals, got along fine.

So did the colonists. A pet hung outside your door would tell you—by rattling its cage and chirping—when a Wock was around, so you didn't walk

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out into one unexpectedly. It would warn you of a Wock approach fast enough to let you unlimber your beamer and shoot—and colonists do tend to have good aim.

I waited around, for that week or so—the rest of the three months had been spent in making cages, trapping pets, and explaining to everybody how the solution worked—waiting for something nobody had thought of to go wrong.

It didn't.

And where did I get the idea? From Roebuck Witherspoon's mining ambitions. Miners used to have warning birds, too—canaries, if memory serves—to tell them when the air was going bad on them; the birds keeled over before the miners could, and gave them a chance to get the Hell out.

One of these days I'm going to hunt up Bruno Carr, between his assignments, and tell him how he should have worded his report.

Not that it'll teach him anything, damn it. ■

IN TIMES TO COME

Our July/August issue is our annual "double," offering roughly twice your usual dose of the things you read *Analog* for. Catherine Asaro returns with another strange and colorful tale of the Skolian Empire, with a dramatic cover by George H. Krauter. Give human beings enough room and enough chance to spread out and develop in different directions, and you can count on them to develop some very strange cultures. One, for instance, in which a "mere game" serves several of the most important functions in the operation of the society, and its players occupy a unique position. And in which a visiting anthropologist can discover that it's possible to get entirely *too* wrapped up in one's work. . . .

Our fictional lineup will also include a wide variety of stories by such writers as Mike Moscoe, James Gunn, Michael F. Flynn, Larry Niven, Laurence M. Janifer, and Shane Tourtellotte. And we'll have several kinds of nonfiction features: Dr. Kyle Kirkland's science fact article on "Brain-Machine Interfaces," Marianne J. Dyson's personal account of NASA weightlessness training, and Dr. William Sims Bainbridge's "State of the Art" feature on "The First Martians." "State of the Art," in case you don't remember (since it's been a while since we had one) deals, broadly speaking, with science fiction and education. In this case the question Dr. Bainbridge tries to answer, by asking the people involved, is simple and highly pertinent to both fields. If, sometime fairly soon, we need to recruit volunteers to colonize Mars, who will go?

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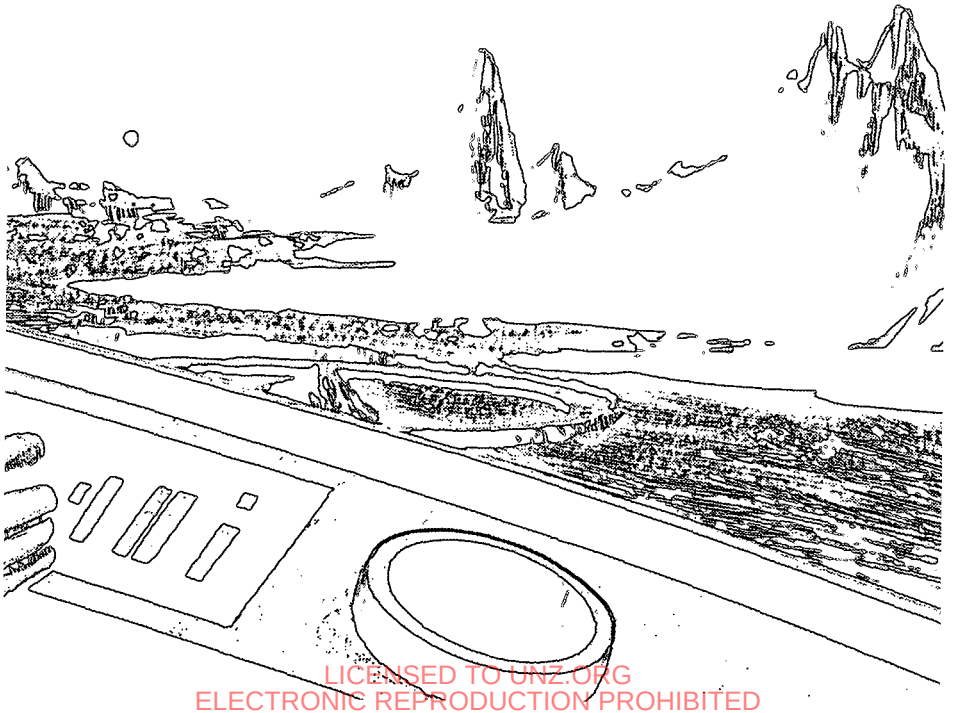
The most effective learning experiences are not necessarily the ones we'd choose for ourselves. . . .

A THREAT OF CINNAMON

Rajnar Vajra

Illustration by Vincent Di Fate



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On January first, 2070, I am standing on Devonshire Street in Boston, Massachusetts, aiming a swollen index finger accusingly at the southern sky. My watch claims it is precisely noon, but the damn thing isn't trustworthy: it loses almost a second per decade.

"See where I'm pointing, Peter?" I say. "If the Sun wasn't washing the stars out, you'd be able to see Vega right about . . . *there.*"

My grandson is silent for a moment, his lips squeezed by intense thoughts. His delicate face, oddly studious in one so young, has a milky glow in the winter sunlight and his clear brown eyes are carbon copies of my daughter Jody's eyes. The boy looks so precious to me, it makes my heart sting.

"You told me about Vega before, Grampa Scott. Didn't you?"

"So I have."

"Vega," Peter says slowly, rolling the word around his mouth like a connoisseur sampling a wine.

"Means 'swooping' in Arabic. The ancient Egyptians originally named the star 'vulture' and when—"

"But it doesn't look like a bird, does it?"

"Not to me, it doesn't. Remember last summer when I came to visit? You and I went out on the back porch and we turned off all the lights and sat on your mom's big glider-chair together and looked at the stars. That's when I showed you Vega."

"I remember! Except I can't remember what it *looks* like."

"It's bright and blue-white." I recall, with a painful twinge, that my Companion had once dubbed it a "bleached sapphire."

"Is Vega where you died, Grampa?"

"More or less. An enormous dust field surrounds the star like a—I don't know—maybe a big flattened donut around a baseball. Twelve asteroid belts hide out in that dust field. You know what an asteroid is, don't you?"

"Sure I do!"

"Good for you. As a group, the belts are known as the *Lyraeads* and *that's* where I died, on this huge crazy rock we called Charlie Horse."

"What a funny name." Peter's nine-year-old face is temporarily almost as wrinkled as mine; he is squinting at the bright sky as if he might pick out Vega after all.

"Charlie Horse is a funny little world, Peter. It's the Mr. Magoo of asteroids." The statement earns me a blank look. "Ever see Mr. Magoo? The cartoon?" I'm wondering if the show is still running after all these years.

"I don't like cartoons."

"What I mean is, the Lyraead asteroids mostly orbit Vega in the same direction but not good old Charlie. It kind of bumbles through all sorts of debris and somehow never bashes into anything big enough to hurt it. Not lately anyway. There's strong evidence that it wasn't always so lucky. From its shape, we think Charlie was created not terribly long ago, as such things go, when two huge rocks bashed together. Maybe someday it will hit something else; no one knows for sure."

"Why not?"

"Because the motions and interactions are so complex that—tell you what. Let's discuss this when you're a little older. Maybe next year when you're ten."

"I'm old enough right *now,* Grampa!"

"Then I'll let you in on a secret: It was twenty years ago, almost to the minute and right here on Devonshire Street, when I got the phone call."

"What phone call?"

"The one saying I'd been chosen for the loneliest job in the universe. I've got an idea. Let's you and me go someplace warm where we can snag some hot cocoa. Then I'll tell you all about it."

I am old before my time. In our new, shiny world of telomere therapy and cartilage "plating" I lumber around like a di-

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nosaur with my swollen joints and liver spots. Yet for me, each new day is purest gravy and I have reason to be content . . .

About the time I was Peter's age, it became clear to me there was only one job worth having: being an astronaut. In the fourth grade, I drew a picture of myself in a spacesuit, labeled it "Scott J. Lydell, Space Explorer," and pinned it proudly to my bedroom wall. "Obsessed" wouldn't be too strong a word.

Trouble was, I was growing faster than a bamboo sprout and it looked like I might even overshoot my father who was six five and wide as a bus. Big people may be desirable to the NBA, but NASA, which must accelerate objects to almost eight kilometers per second just to get them into Earth's orbit, resented every extra inch and pound. They wanted astronauts who were fit, but small and light, and would surely have hired elves if any had applied.

But I had my stubborn heart set on being at the core of the U.S. space program (even though its funding was pathetic at the time). So I got a Master's in astronomy and another in systems engineering. That way, I figured, I could at least work in space from the ground. It seemed the best I could hope for. Somewhere in there I also got married and my wife got pregnant, but these mundane matters dimmed in comparison to my fixation.

And sure enough, NASA *did* offer me employment . . . after I'd pestered a certain acquaintance for five frustrating years. Unfortunately (or so I thought), the work they wanted me to do was closer to mechanical engineering, than systems engineering and I'd never been deeply interested in nuts and bolts even when they were made of titanium-vanadium alloy.

But I took the job (and a pay cut) anyway—hell, it was my *dream!* But two months later, researchers at M.I.T. discovered the "tau charge," which led immediately to the discovery of "photonic gateways." And these gateways turned the space program, and my life, upside down.

I'll never forget how weird it was. One day the stars seemed forever beyond our reach, the next day certain ones seemed right next door. Photonic gateways, which we quickly nicknamed "Blue Holes" or "Snakeholes," are transdimensional shortcuts to stars that are first magnitude in *both* relative and absolute terms. So Arcturus or Betelgeuse or 13 Alpha Aurigae, for example, is accessible from the general vicinity of Earth under the right artificial conditions. But Sirius, the stellar jewel of the night sky, has an absolute magnitude of only 1.41, which is respectably bright but doesn't make the cut.

That was the year I had my fatal stroke of good luck.

NASA had assigned me to a development team for a solar-charged, disk-shaped lunar vehicle officially named the "Regolithic Courser" and unofficially "Dust Bunny." The idea behind what came to be called Project Rabbit was to use dust as an endlessly renewable propellant. The concept was impractical on Earth, but the Moon's lesser gravity and lack of air pressure made the idea feasible enough to open the government's wallet and pull out some fairly large bills.

Here's how Bunny worked: Mechanical arms would gather up surface debris, the larger rocks would get strained out and the remainder would be ground to powder, placed into a central reservoir, and from there pumped into nearly frictionless, conical tubes: the "jets."

When it was time to fly, the powder would be given a massive charge and compressed air would push a flexible, sealed diaphragm into the top of each tube. The diaphragm would retain the air, but pressure would violently force the powder out a small, operable hole in the bottom of each jet where electrostatic forces would give it a major kick in the pants.

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There were jets beneath the hull and directional jets around the hull. Only half the jets fired at a time so that the others could be refilled. When all dust was gone, the air would be recompressed and the whole process could begin again. The craft was clumsy and godawful unstable and a bit slow, but surprisingly reliable so long as the operator remembered to douse the power cells with direct sunlight now and then.

Recharging took less time then you might imagine. Three thousand movable, dielectric mirrors, each with nine layers of polystyrene and tellurium, made Bunny a wizard at gathering sunlight. This raw energy was focussed on photovoltaic structures that could be elaborately folded to enhance efficiency since they weren't responsible for actually gathering the light.

NASA was working on the Regolithic Courser in conjunction with a recently resurrected engineering firm from San Diego, New General Dynamics, and somehow in the confusion of authority *I* wound up in charge of the entire project.

So I took shameless advantage of my position by being the first person to train on our Dust Bunny simulator. And believe me, Bunny took getting used to! Maybe someone, somewhere, has invented a bigger, trickier machine to operate. But I doubt it.

"Monsieur Peter," I say with the appropriate fake accent, "I am admiring your new moustache."

"Do I have cocoa on me, Grampa?"

"*Mais oui.* I think it makes you look dignified."

My grandson reaches for a napkin, apparently having his own standards of dignity. The air shifts and I am suddenly troubled by a smell wafting over from a nearby table. I used to enjoy the scent of cinnamon, but not anymore.

"How did you get picked to go to the stars, Grampa?"

"The government was in a big rush to get miners out there, and I was one of the few people who knew how to use the new mining vehicles."

"But why was the government in a rush?"

"Because people had used up the Earth's supply of . . . well, lots of important things."

"And you can get those things on Vega?"

"Not *on* Vega, Peter. In those asteroid belts I was telling you about. I'm sure many star systems would have the same resources."

"So why not go to one of those other star systems?"

"Ah! That's a smart question but the answer is kind of long."

"I don't mind."

"You know, I saw you playing with your dad's lightning-ball yesterday."

Peter's eyes widen in outrage. "But I had permission!"

I chuckle. "I wasn't picking on you, son. I've got a point to make. When you put a finger on the outside, lightning goes right to your finger. Yes?"

"Sure," he says, still suspicious.

"That's because there's a big difference between the energy in your finger and the energy inside the sphere. When you touch the glass, you automatically make yourself part of an electrical device called a 'capacitor.' Your hand is one conductor, the molecule-thin coating of metal inside the ball is the other, the non-conducting glass itself acts as a partial separator called a 'dielectric.' Capacitors store and discharge energy . . ."

I'm not certain if the youngster is following any of this.

". . . and the gas atoms inside the ball get hot and bothered because of the extra energy stored by this half-Peter capacitor and they discharge as close to your hand as possible." I plunge into the main point. "The gateways we use to reach the stars work a little like that. Only, instead of a difference in electrical energy, they use a difference in something called a tau charge."

"What's *that?*"

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"It's a force that can warp the shape of space the way massive objects warp space-time to create the effect of gravity. Only . . . a tau charge comes from a big bundle of *time,* not matter. And its effects are more selective. One tiny spot in the universe can get stretched out like piece of gum. But the stretching happens in a dimension we can't see. If the charge is strong enough, you get an instant tunnel between points in space that are normally separated by hundreds or even thousands of light-years."

"What makes a tau charge strong enough?"

"Photons. Lots and lots of photons. That's why we can only go to the brightest stars."

Peter is staring at the tabletop, nodding his head knowingly. Is it possible he understood my elaborate and rather lame explanation? He glances up at me with a sudden frown on his face. "But, Grampa, what are photons?"

"The . . . particles that light is made of. Let's call them particles because that's easiest. When a particle moves really, really fast it has a time-flow much slower than normal reality. If you get enough of them together it creates a 'temporal mass.' The temporal mass holds the tau charge and a strong tau charge can produce a photonic gateway, that tunnel I was telling you about. We set up a very bright 'conductor' halfway to the moon and a big, black, non-magnetic shield to be our 'insulator.' Then, just like the lightning ball, a distant section of space-time reaches out to us like . . . like a reality-bolt. By the way, the trickiest part in using a photonic gateway is not winding up *inside* a star."

"If you say so, Grampa." Peter is silent for a minute, contemplating the dregs of whipped cream in his mug. I wonder if so much complexity has emptied his interest in our discussion. Then: "But what were you mining on Vega? In those asteroid belts, I mean."

"Lots of things. Platinum was probably the most important."

"What for, Grampa?"

"Hydrogen fuel cells in cars and trucks. The anodes of the cells are plated with platinum to act as a catalyst. That makes the hydrogen—" I stop and assess my audience. "Sorry, son, I'm going all scientific on you. I didn't invite you out today to bore *or* confuse you."

"But I'm very good at science, Grampa. And I'm not bored or confused, not one little bit. What else were you mining besides platinum?"

"Helium. We'd pretty much run out of helium about thirty years ago."

"What is helium good for?"

"Scientific experiments. Diving and deep-ocean submarines. Making things really, really cold. When I was a kid, it was used to fill balloons, made 'em float in the air. And if you breathed in some gas and said something, your voice sounded funny." The boy looks at me as if I'm pulling his leg.

"OK. So you were mining helium."

"Cleveite. That's an ore rich in helium. And we were searching for gold and also for a mineral called monazite, which is a good source of rare earths."

My grandson finally looks a bit dazed but he's still game.

"What do we need all *that* stuff for?"

I strive to keep a straight face. "One of the rare earths is praseodymium. Makes a wonderful deoxidizer. And gadolinium stops neutrons like nobody's business; you don't want to mess with atomics without heaps of gadolinium. Then, of course, we have what many would consider the most important use for rare earths: adding cerium and lanthanum to iron to make misch metal."

"*Misch* metal? You're making all this up, aren't you, Grampa!"

Against my will, my lips stretch into a full grin. "No, I'm not making anything up, not exactly, but I *am* teasing you a tad. This is pretty heavy stuff to throw at a nine-year-old, even one as bright as you."

"There's really something called 'misch metal'?"

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"You bet. If you scratch it, it makes sparks."

The boy thinks this over for a time. "And the sparks do something important?"

"Depends on who you ask. Misch metal is used for the flints in . . . cigarette lighters."

Innocent brown eyes regard me suspiciously and the next question catches me completely off-guard. "But how did you *die*, Grampa?"

No genius has yet come up with a program that would allow a computer, even one with latest anti-radiation safeguards, to safely fly a Dust Bunny in an unexplored environment. Too many judgement calls involved.

But training a human for the task is a long and usually disappointing proposition. Very few people can make the grade in three crucial areas: extremely fine motor coordination, spatial visualization, and being able to maintain an almost saintlike patience for long periods. Even today we lack a reliable test to determine, beforehand, that a given individual has what it takes.

Likewise, training someone to pilot an asteroid-shuttle can't be done overnight.

So the most practical way to exploit the new resources opened up by Blue Hole technology was to divvy up responsibilities. Two pilots would ferry a miner and his Bunny to a promising asteroid (determined, in Vega's case, by analysis of data from the locally placed Humiston Space Telescope). Then, if close-up inspection confirms that the asteroid has the right stuff (including a regolithic layer), the miner gets dropped off. The pilots would (with luck) return six months later to haul the full Bunny back to Earth. Of course, the miner was welcome to go along for the ride if he or she were still breathing.

Perhaps I made the ferrying and dropping-off part sound too easy. While it is possible to adjust photonic gateways with astonishing precision, there are dangers in being *too* precise. An asteroid-shuttle could, theoretically, be deposited practically on top of a given asteroid but the results would likely be . . . unpleasant.

The speed and motion differences between any spot on Earth and, say, Charlie Horse are extreme, to put it mildly. Luckily, the timeless journey through a Blue Hole eats up most of that differential, but "most" is scarcely enough. So shuttles are always placed into relatively empty space and their pilots typically have to decelerate or accelerate like hell for weeks before they can think about going to specific destinations and matching orbits.

Many theoretically attainable star systems are off limits because the speed differential is too great. But, ironically, for systems such as Vega's or 50 Alpha Eridani's, it's far easier to reach *their* asteroid belts, absurdly far beyond our heliopause, than the one right next door between Mars and Jupiter.

Even though good old Sol is rather dull as stars go, a Blue Hole, once opened artificially, retains its conductivity for almost a solar year. And that is what we call a money-saver.

A ruin with a view!

Charlie Horse proved to have its own powerful and exotic flavor of beauty. I'd expected an environment with Luna's awesome solemnity and desolation, but this terrain looked more abandoned than desolate. The forces that had shaped the asteroid had given the hills, valleys, mountains, and even many of the rocks, an unexpectedly organized appearance. Charlie was a world of patterns; a world of curved, graceful ridges and well-defined symmetries.

The place seemed unnatural somehow and only the occasional, lunar-style crater spoiled a sense that I was stuck on some giant, long-forgotten sculpture.

My wife and children were twenty-six light-years away, and, to my surprise, I felt every inch of the separation. For the

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first time, it occurred to me that I hadn't bothered to ask my wife how she felt about my volunteering for this mission. What didn't occur to me at this point was that I should have sat down with her and discussed the matter *before* volunteering. The trouble with blind spots is that you don't even know they're there . . .

Virtually everyone who has walked on Earth's moon, from Armstrong and Aldrin of the Apollo 11 mission, to Schmitt and Cernan of Apollo 17, to the latest arrivals at Strock Station, has remarked on how hard it is to gauge distances in an alien environment. A rock that seems close at hand can be a mountain *miles* away; the mind lacks a framework on which to base such judgements.

The early astronauts had it easy; the Moon is as comfortable and familiar as an old shoe compared to places like Charlie Horse. What's worse is that my life would soon depend on the accuracy of my perception.

At least *seeing* all the bizarreness was no problem. We'd built a sophisticated virtual-style window termed a "fauxshield" into each Dust Bunny. Like similar windows built into, say, military tanks, fauxshields have photomultiplying abilities for night-vision, magnifying options, and visual filters for dust. Unlike conventional virtual windows, however, a fauxshield constantly repositions itself depending on where you're looking. That is, if you turn your head to the left, you can see the terrain to your left as if there were a big, rectangular hole in that side of the vehicle. If you look straight ahead, the "hole" shifts forward. The weirdest part is looking straight down. You seem to see right through your own legs, the seat, and the Bunny's floor.

Flying a Bunny over Charlie Horse, the most important direction to look was usually down . . .

After the first two weeks of intense activity—setting up base camp, assembling my smelter and refining machines, and adjusting to an environment that seemed flat-out *wrong*—my Companion began showing unmistakable and alarming signs of personal development.

I'd better explain why we created Companions.

Single-person missions are against NASA policy: too risky. But the Powers That Be made an exception for mining operations. There simply were too few Bunny jockeys to "waste" any. Not to mention the engineering and life-support problems that would have multiplied with more than one person on each Regolithic Courser. But we knew it was going to take about six months of mining to justify the phenomenal expense of a deep-space mission, so our jockeys were going to be stuck in solitary for a long, long time.

Solitude yes, privacy no. We were going to be monitoring these lucky devils (including me) six ways from last Sunday and all that juicy information was going to be recorded and studied in depth when the assignment was over. (All in all, quite a damper on one's sex life, if you know what I mean.) Some of the monitoring was necessary anyway for practical reasons such as tracking a miner's head position to properly direct the fauxshield, and keeping tabs on oxygen and CO_2 blood levels to adjust air-quality. But if a miner died, we wanted to know precisely what went wrong and how to stop it from happening again.

Walt Crawford had a brainstorm about providing miners some interesting company during the long wait. Walt was one of the computer specialists involved in Project Rabbit—a tall, dank, and lanky fellow with a wee beak of a nose and the thickest eyeglasses ever made. He always spoke in a whisper. And he was creative. He was one of those rare people who could rub two sticks together to start a fire and wind up inventing the letter "x."

Walt recommended that we include

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an AP, an artificial personality (with, of course, a voice) in the programming for each Bunny's mainframe. Nothing new there. But Walt further suggested that the medical data stream coming from the biosensors in a star miner's command helmet be continually fed into the artificial personality. Supplied with "algorithms for favorable or unfavorable response" taken from each individual miner, the artificial personality could gradually rewrite itself in the "direction" of favorable responses. An unusual, but logical form of biofeedback.

As a prospective prospector, I took the same tests as everyone else. I sat alone in a room, wearing the same kind of wireless helmet I'd be using on the job, and was subjected to a series of what psychologists casually refer to as "stimuli." Then I had to push one of five buttons to rate my response while computers made correlations with my physical data. The test took four hours and by the end I'm afraid I ran clean out of favorable responses. By then, as I recall, I was furious with myself to agreeing to such an idiotic proposal.

But after two weeks on Crazy Horse it dawned on me that Walt's little experiment was more . . . intense than any of us had dreamed.

When I awoke on that fifteenth day, my Companion greeted me by saying, "Ambiguous day, Scott."

I blinked a few times before asking, "What do you mean?"

"The quality of this day is susceptible to interpretation."

That was a showstopper. The AP had never talked like that before; in fact, the personality had previously been dull as lukewarm milk. It occurred to me that the Companion's voice *had* been subtly changing since I'd first landed, becoming a bit breathier and more . . . feminine every day. A small shard of worry began poking at me.

"Maybe it's time," I said slowly, "to give you a name. Any particular one strike your fancy?" This, of course, was a test. The way the AP was designed, it should simply throw the question back at me.

"Kelly."

"Hell, no! That's my *wife's* name!"

"My second choice would be Jody."

My daughter. When I got back, I was going to have a few special words saved up for Dr. Crawford. A memory of HAL, from *2001: A Space Odyssey,* intruded into my already fragile peace of mind. And if the AP had reprogrammed itself according to my preferences, and I felt this scared right now, what did that say about *me?*

"How about this: we'll call you Lynn." Lynn was my wife's middle name.

"I would enjoy that very much."

Would you now, I thought sourly.

That night I had the worst nightmare of my life.

My subconscious must have been working overtime and had come up with an idea that was as rational as it was terrifying. Since my fauxshield was mediated by computer and since the computer had been given an AP, and since the AP was supposedly modifying itself based on what pleased me . . .

In my dream, I was flying Bunny over a high mountain ridge and the view outside was relentlessly transforming into puffy clouds and rainbows and fairyland spires. I begged the AP to let me keep seeing reality, since I would crash otherwise, but the monster informed me that the new view would be far more to my liking.

Next morning, I confronted my fears.

"I would never distort your view like that, Scott."

"I'm glad to hear that, uh, Lynn. But . . . why wouldn't you?"

"There are safeguards inlaid into my programming. And such deception would be gravely dangerous and you certainly wouldn't enjoy that."

I would have been more reassured if the AP had said it *couldn't* distort the view.

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I'm not sure when I made the transitions from being afraid of Lynn's company to tolerating it to actively relishing it. As my initial scare faded, I began to appreciate how inventive my AP was becoming. I guess Walt's four-hour assessment test had been effective after all, revealing how much sheer verbal inventiveness and surprise tickles me. Each day, she (and yes, I'd begun to think of her as female) delighted me with unexpected and creative ways of expressing herself. When she started using concepts such as "near-fetched" to mean something that was likely to happen, and when she called Vega a "bleached sapphire," I not only forgave Walt Crawford, but I resolved to send him a box of chocolates at the earliest opportunity. My impossible job became almost bearable.

Within weeks, Lynn was more than important to me; she was indispensable. After all, she was all I had.

In those early days, NASA hadn't figured out any way for Vegan miners to communicate with each other. Not only were the distances involved vast, but Vega's powerful emissions produced massive electromagnetic interference. And the dust cloud itself made laser-links impractical. So there were only two voices in the cosmic silence as far as I was concerned, hers and mine. I hate to admit it, but more often than not, I forgot I was conversing with a machine.

Meanwhile, my stress level was fantastic. We'd picked the best site we could for base camp, but the temperature fluctuations outside were severe and even the best machines have a nasty habit of freezing up under inconsistent conditions. If something went wrong with my Dust Bunny, Kelly would never forgive me. And it wasn't just my vehicle that was a source of anxiety. I fought for days to get the damn smelter working properly and I *never* felt confident that its few moving parts would keep moving.

Then, after weeks of preparation, it was time to begin exploring my giant prison in earnest. This meant the mission was about to get even more dangerous. And my chief enemies were likely to be low gravity and impatience.

Not that the gravity was as feeble as you'd expect from an S-type (stony iron) asteroid. Charlie is a big chunk of real estate (although 1 Ceres in our own solar system is far larger) and it's astonishingly massive for its size. Earth's moon has six times the diameter, but Charlie has more than *half* of Luna's pull. A man weighing two hundred pounds on Earth would weigh about eighteen pounds where I had my base camp. Some truly compact matter undoubtedly lies hidden in Charlie's heart, a fact that supports our notion that the rock isn't native to Vega, but a refugee from parts unknown. To this day, we haven't found many asteroids anywhere, even M-types (almost entirely metallic) with such impressive mass and we've never found an object this massive that was so irregularly shaped. That's one of the reasons we were sure the asteroid, in its present form, was in its infancy. Eventually, of course, you'd be able to put Charlie on God's tabletop and it would roll reasonably straight.

High density gave us hope we'd find useful metals lying about on the surface. Buried treasure wasn't going to do us a bit of good for I was going to be doing "placer" mining only. Bunnies aren't designed for excavation but only for scooping up loose ground materials with their dust-gathering arms.

Low gravity and impatience. I had no idea these things were going to be the death of me . . .

My little world was only roughly spherical. Some Titan had held the poor thing between two planet-sized hands and given it a half-twist. The result was curving, mountainous ridges that sometimes reached seven kilometers high. Seen from space, Charlie's daylight side had graceful stripes. To certain soulless

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astronomers, it looked like clenched muscle fiber—thus the name. To me, Charlie seemed more like something you might hang on the ultimate Christmas tree. The areas I needed to reach were, like my base-camp, in the deep shadows between ridges.

That's where danger jumped in with both feet. I had only so much dust for fuel and I had to land *softly.*

I'd fly up to the top of a ridge, move over the edge (usually weak-gravity sharp) while trying to avoid even an extra inch of unnecessary height. Then I'd gaze downward to a ground that was kilometers away but seemed at the same time infinitely distant and yet, somehow, close enough to touch. If my fauxshield wasn't clarifying the view, of course, all I could have seen, even in daylight, was my own dust. After I'd crossed to the inner side of the ridge, I'd make sure Bunny was level, take a deep breath, and the game would begin.

My tendency was to apply the brakes too sparingly. I'd drop and squirt dust and drop and squirt more dust and the only way I could tell I was moving at all was that the ridge walls kept looking higher. The low gravity gave the descent, which often took several hours, a deceptive and potentially fatal languor.

For the distinction between weight and mass had sharp teeth on Charlie Horse. My Bunny, even unloaded, was so massive that if it hit the ground after a mere four-foot fall (which would take more than a second), my vessel would crack open like a raw egg.

By the way, if there's a more agonizing way to die than death by vacuum, please don't tell me about it.

I did have a spacesuit, but if Bunny cracked, all hell and a lot of carefully machined components were going to break loose. Back home, people flying at high altitudes in jets have gotten sucked out of tiny, broken windows. Relatively speaking, *they* had a surplus of air outside. Barring a miracle, my spacesuit was going to be no more useful in a hull breach than a fire extinguisher in a live volcano.

So pace was critical. Descending too slowly, I'd run out of fuel. On the other hand, if I got going too fast, momentum (where mass really counts) would force me to use up too much dust to decelerate and, again, I'd run out of fuel.

Naturally, Lynn tried to advise me and faithfully kept me abreast of the altitude, but there were complicating factors: Charlie was small enough and irregular enough to make the gravity somewhat, well, *whimsical.*

On Earth, if you grab a twenty-pound turkey at the supermarket and carry it to the top of a ladder that's 7,000 kilometers high and pay for it up there, you'll get a hell of a bargain. The turkey will weigh a little less than four and a half pounds. On a relatively small rock like Charlie, a mere seven kilometers makes a *big* difference. Not that gravity attenuates faster on an asteroid (it always shrinks by the square of the distance); it's a matter of it starting out so much smaller. But the weirdest part is that Charlie's irregular shape puts crazy vectors in the pull; you can't always count on dropping straight "downwards."

So I had to fall by the seat of my pants, as it were, using my eyes and intuition and a constant stream of information from Lynn. And each fall began so damn *slowly.*

On these occasions, Lynn would usually tell me to let my muscles "lengthen," meaning I should relax. Sometimes she played soothing music or told hoary old jokes with peculiar twists at the end.

"Did you hear about the optometrist who fell into his lens-grinding machine, Scott? I understand he made a spectacle of himself."

"Oh."

"Later on he was accused of murder but that was only because he'd been framed."

Her efforts seldom worked. Too much was at stake.

The most dangerous descents were

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the first few, because my judgment of distances was atrocious at first. However, we expected that, so we didn't attempt any of the deeper valleys for more than a month.

As I grew more experienced, we took bigger and bigger risks. And one fine day in the third month they paid off in full.

When we got low enough, I noticed that a certain valley floor displayed an unusual luster. My landing was no more than a bump and a series of creaks (which I'd learned to ignore) as Bunny settled in. I gazed through my fauxshield and found the view pleasant indeed because I'd been trained to recognize certain minerals and ores by sight.

The nice thing about platinum in the raw, as it were, is that it usually includes other valuable "platinum metals." Lynn's assay on the spectacular deposit I'd stumbled on showed the entire happy family: ruthenium, rhodium, palladium, osmium, and iridium. And the best part was that this one deposit was more than big enough to fill Bunny's cargo hold. And the best part of the best part was that I wouldn't have to use any of the dubious refining equipment I'd set up so laboriously. The platinum was already pure enough.

After this discovery, my heart felt lighter and our mission changed. Now the job was simply to map the asteroid, locate as many deposits as possible, and mark them on the map for future miners who weren't going to be me.

Maybe I began to get a little cocky.

At the end of the fourth month, mornings were down to a routine. Wake up, sponge off, eat breakfast, sip coffee, use the head. Check various systems, water the plants, confer with Lynn, and do the first of three grueling fifteen-minute daily workouts on the isometric exercise machine. Heavy exercise was crucial if I expected to be able to stand up when I got home. Without countermeasures, low gravity swiftly melts away muscle and bone. After my workout, another sponge bath and a "dry" shampoo. Then it was time for a medical checkup by Dr. Lynn before firing up the jets and going exploring. In the checkup, my biggest concern was radiation sickness.

On Earth, grateful people are always kissing the ground, but I think they should start out by kissing the *air.* Our atmosphere not only feeds us our essential oxygen and provides us our essential water, it's our greatest protector. Old Man Sol would seem a whole lot less kindly without our gaseous security blanket.

The only atmosphere on Charlie Horse was a temporary one I created myself every time I flew the Bunny. Dust. And in terms of radiation, Vega wasn't nearly as affable as Sol.

We shielded the Regolithic Coursers as much as possible, but radiation has a nasty way of turning shielding itself into secondary particles. Part of my job was trying to stay out of the sun. Unfortunately, Bunny had to be *in* direct sunlight to recharge so I couldn't avoid it completely. By the fifth month, my radiation level had become very worrisome and there wasn't a damn thing I could do about it.

When the day's work was over, I'd exercise, eat, maybe watch a movie, and then have a long talk with Lynn before hitting the sack. We kept returning to one subject over and over: consciousness. I wanted to know if my Companion was self-aware, but could never come up with a way to tell for sure. She sure *seemed* conscious.

I made my big mistake only eight Earth days before I was due to be retrieved.

We were flying well over seven kilometers up, crossing one of the tallest ranges we'd yet encountered, when I noticed an interesting notch on the peak below me. Perhaps a meteor had smashed through the stone at some point. The damaged area appeared half-

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melted and it reflected Vega's oxyacetylene glare with a suspiciously golden gleam. I consulted Lynn and concluded that if we landed on the rim to investigate, we'd still have enough dust to descend into the next valley with a small but reasonable safety margin.

Famous last conclusions.

The golden gleam had a logical explanation. The entire area was liberally splattered with droplets of remarkably pure gold, twenty-two carat by Lynn's assay. A meteor with the Midas touch?

I used Bunny's arms to gather up a few choice nuggets but we were already fully loaded with something more valuable than gold. So I merely noted the deposit on the map and took off again.

The long, boring fall seemed to take its usual eternity and I was so used to the procedure by now that I compensated for a constant, sideways drift without thinking twice about it. We were, of course, falling straight toward Charlie's centroid . . . but Charlie's shape was so irregular that the centroid wasn't directly below us.

And I was in too much of a damn hurry. At one point, halfway to the ground, I allowed Bunny to drop for ten seconds—about five seconds too long. Lynn called out a warning, but the damage had been done. My mistake wouldn't have been so serious without the sideways drift. The side jets weren't quite perfectly aimed and when they fired, the craft tended to tilt, which put *all* the jets in the wrong position, which increased the tilt. Vicious cycle. So I'd been automatically compensating, as always, by firing some of the bottom jets a little harder than the rest.

But this time I'd used up extra dust to slow down after the long fall. Once Bunny gets moving, she isn't easy to discourage. When Lynn warned me there might not be enough fuel left to land safely, I swear to God, she sounded scared.

I wasn't bored any more. I sweated like an overworked horse in my desperation to husband every last grain of dust. I controlled that fall with a concentration and urgency I'd never felt in my life. The whole time, Lynn kept calling out soft words of praise and encouragement.

"Great work, Scott! You've never piloted so efficiently before! You can save us, I know you can!"

And I damn near did.

A lousy five feet over the ground, fuel finally ran out in Bunny's outer starboard jets and the machine abruptly slanted in mid-air and smashed into the ground on that side. There was an appalling thud and a sound like the great-grandfather of all sneezes. Suddenly we were slanted the *other* way and only my safety belts kept me in my seat. There was another godawful thud, all the jets shut down and the machine crashed down onto its underside with a finality that had the feel of death, like a holed ship temporarily sitting normally in the ocean.

I listened for the shriek of escaping air . . . and heard nothing but the normal creaking of metal and the pounding of my heart.

Then I smelled cinnamon and knew that I'd killed myself after all.

Cinnamon aroma was the warning sign that something had gone seriously wrong with the air-supply. We had chosen that scent in particular because it was pungent without being, at least for most people, unpleasant. Why torture someone dying of anoxia with a really bad smell?

"Lynn!" I cried out. "What's going on?"

There was a moment of silence and my old fear about the AP came out of hiding. Would my Companion be willing to provide truly bad news? I wished I'd learned more about the safeguards she'd been given.

When she finally spoke, her voice was no louder than a whisper. "I don't wish to cause you distress, Scott, but the primary air-tank is now reading empty. Perhaps the pressure sensor was damaged in the crash."

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In a strange way I was relieved. I needed to be able to count on Lynn if I was to have any chance at all.

"I'd better go take a look. How the hell could the tank be empty while the hull is intact?"

I unbelted myself with trembling hands, got up, and turned a little wheel that unlocked one of the floor panels. Then I carefully lifted the panel out and, using only my arms, I let myself down a ladder to the machinery and storage level.

The mechanical gauge also showed that the tank was empty.

Baffling. For a minute I worked on a crazy theory about the crash: the hull had cracked in a small spot directly under the tank and the forces at work had cracked the tank too. The compressed air had rushed out, of course, but then, in some freak of sudden vacuum and extreme cold, the metal of the tank had welded itself to the metal of the hull and sealed off . . .

No sir, the idea was ludicrous.

I climbed back upstairs, returned to the flight chair, and tried to calm down and think clearly. It's embarrassing how long it took me to work it out.

One or more of the flexible diaphragms that prevent air from escaping while dust is forced out the jets must have ruptured. Simple as that. Simple as a mortal wound.

Bunny was one enormous vehicle, but much of the space was filled with cargo and machinery. Still, there was at least a day or two of air on board. And I had trays of modified algae and even a few houseplants growing in damp vermiculite that put out a little extra oxygen every day. Maybe I could even produce more by setting up an electrolysis tank . . .

Lynn and I did some calculating. At the very best, I might squeeze in four more days of breathing if I kept very still and stayed very calm. Houdini could have probably survived for an entire week.

Too bad my retrieval ship wouldn't be showing up for *eight* days.

I dictated a distress message outlining my situation and set it up to be automatically broadcast every ten minutes. Then I cobbled together the electrolysis tank. Then there was nothing to do but wait.

For me, waiting to die was a magnifying glass of the soul. My mind automatically became a focussed pinpoint of bright concentration and I began to see details of my life with a new, horribly sharp focus.

At first I tried to distract myself from so much uncomfortable clarity. I had Lynn select movies from the Bunny's large collection and play them on the fauxshield. That took up most of one day. Then I suddenly realized that my limited time was far too precious to throw away and I stopped the movies, sat quietly, and let insights batter my pride.

To begin with, I was one selfish bastard. Drawn by a childhood dream, I'd snatched at this mission without considering what it could mean for Kelly or my two children, Jody and Tim. And Tim was only a baby; he was never going to have a chance to know his father.

And what kind of a father was I? Not abusive, perhaps, like my own father had been on occasion, but abysmally neglectful. I'd put my career first and second and third, and my family last. How many important events in Jody's life, important to her, had I missed already? My wife had tried to talk to me about such things and I'd only made clever excuses.

Perhaps most parents make such disastrous mistakes and they come to a point, when it's too late, when they finally see what they've done. These are the lessons that life teaches *adults* and it's a damn shame that children have to pay such a heavy price for them.

Time passed. I wrote apologetic letters to my loved ones and added a few details

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to my will. Lynn and I had many long, quiet discussions and I admitted how much I appreciated and loved her. Lynn told me she loved me too and wasn't going to let me die. I started getting dizzy at the end of the third day after the accident and from then on my memory is fuzzy. I'd intended to get into my spacesuit at the last moment for a few extra hours of life, but it didn't happen. I don't really remember ever gasping for air but I seem to recall Lynn singing the sweetest lullaby . . .

When they found me, they assumed the oxygen had just recently run out because my chest was moving just a little and my heart seemed to be beating, but very, very slowly.

They stuffed me in my own spacesuit, which had been placed conveniently near my flight chair, and carried me to the shuttle. I remained in a coma most of the way home.

"So you didn't *actually* die, Grampa?"

My grandson's beautiful eyes have grown large as the saucers beneath our empty cocoa mugs. I'd been telling him a simplified and softened version of the story.

"That depends on how you look at it. Do you know what a heart-lung machine is, Peter?"

"I think so."

"Would you say a person on a heart-lung machine is breathing? Or is it the machine that's doing the work?"

"What do you mean?"

"Let me explain in my own way. In school I learned about an engineering principle that one professor named the 'Microphones Are Speakers' rule. Do you know how microphones work?"

"Not really," Peter admits reluctantly.

"Well, most of them have a thin membrane inside called a diaphragm. You talk into the mike and this membrane gets wiggled back and forth by the sound waves of your voice. The wiggling produces tiny amounts of electricity that are greatly amplified to move a loudspeaker back and forth. The motions of the loudspeaker move the air in patterns that duplicate the sound of your voice, but much louder."

"But what does that have to do with heart-lung machines, Grampa?"

"I'm getting there. My professor's point was that mikes and speakers are really very similar. He proved this by setting up a small PA system and plugging in a loudspeaker where the microphone was supposed to go and plugging in a mike where the speaker was supposed to go. He put the mike in a separate room so we students could hear, and went and shouted into the loudspeakers. Do you know what happened?"

"What?"

"A tinny little voice came out of the *microphone*. Sure enough, the system worked backwards."

My grandson stares thoughtfully down at his hands on the tabletop and his lips squeeze tightly together. His next words surpass my expectations.

"So Lynn did something . . . backwards to help you out?"

"Good thinking, son! What she did was absolutely amazing. She used the biosensors in my mining helmet in reverse to send messages to my brain. I died, Peter. But before too much physical damage could set in, she took over, beating my heart for me and keeping me breathing, but so slowly that not even Houdini could have come close. So slowly, my body could survive on a mere trickle of oxygen."

"So she saved your life after all, just like she said she would! But what happened to *her?*"

"That's the sad part. There was only one area of her programming she had access to: her personality. So she had to give up her personality in order to rewrite herself as a kind of heart-lung machine. After I recovered I tried to talk to her and . . . well, she just wasn't there anymore."

I am shocked to feel a tear rolling

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down my cheek. After all these years . . .

"That's not fair!"

"I agree with you completely. But that's what happened."

Peter frowns and studies my face carefully.

"I wonder. Did being dead *change* you, Grampa?"

The question deserved consideration. I did suffer a small amount of brain and nerve damage in those last few days, although the doctors claim I've recovered splendidly. Also, with the propulsion system out, Lynn couldn't move Bunny from Vega's noontime glare, which even reached into the deep valley where I'd crashed. By the time I was rescued, I'd been exposed to levels of radiation well past the most generous safety margin. As a result, I look twenty years older than my contemporaries. The problem with telomeric rejuvenation is that the risk of developing some exotic, incurable cancer becomes much greater. With the cell damages I'd received, such cancers were already far too likely.

And yet, and yet . . .

I'd learned things on Charlie Horse that fifty years of living on Earth might not have taught me. And for me, each new day is purest gravy. Just seeing my grandson across the table is an inconceivable treasure.

I *still* miss my Companion. Walt Crawford tells me that what saved my life was, in a sense, my own love for creativity. Among the artificial personalities sent out to the stars, only Lynn showed such capacity for innovation and self-sacrifice in an emergency. I do feel a terrible loss, but it is the greatest comfort to know that there are times when love and trust is fully justified.

My grandson waits patiently for my answer.

"I don't think being dead changed me at all, Peter. But dying did me a world of good."□

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THE REFERENCE LIBRARY Tom Easton

The Eternal Footman, James Morrow, Harcourt Brace, $24, 359 pp. (ISBN: 0-15-129325-2).

Legacy of Prometheus, Eric Kotani and John Maddox Roberts, TOR, $24.95, 268 pp. (ISBN: 0-312-87298-4).

Genesis, Poul Anderson, TOR, $23.95, 253 pp. (ISBN: 0-312-86707-7).

The Stone Canal, Ken MacLeod, TOR, $24.95, 304 pp. (ISBN: 0-312-87053-1).

In the Beginning Was the Command Line, Neal Stephenson, Avon, $10, 151 pp. (ISBN: 0-380-81593-1).

Science Fiction of the 20th Century: An Illustrated History, Frank M. Robinson, Collectors Press (distr. by Universe Publishing, a division of St. Martin's), $59.95, 256 pp. (ISBN: 1-888054-29-8).

Magnificent Universe, Ken Croswell, Simon & Schuster, $60, 210 + x pp. (ISBN: 0-684-84594-6).

The Mammoth Book of Comic Fantasy II, Mike Ashley, ed., Carroll & Graf, $10.95, 494 + xiv (ISBN: 0-7867-0694-5).

When Worlds Collide, Philip Wylie and Edwin Balmer, Bison Books (The University of Nebraska Press, 312 North 14th Street, P. O. Box 880484, Lincoln, NE 68588-0484; (402) 472-3581), $14.95, 384 + ix pp. (ISBN: 0-8032-9814-5).

The Wonder, J. D. Beresford, Bison Books (The University of Nebraska Press), $13, 295 + xii pp. (ISBN: 0-8032-6162-4).

Mizora: A World of Women, Mary E. Bradley Lane, Bison Books (The University of Nebraska Press), $9.95, 147 + xii pp. (ISBN: 0-8032-7992-2).

The Stone from the Green Star, Jack Williamson, Gryphon Books (P.O. Box 209, Brooklyn, NY 11228-0209), $20, 184 pp. (ISBN: 1-58250-025-8).

Rings, Charles L. Harness, NESFA Press (P. O. Box 809, Framingham, MA 01701-0203), $25, 601 pp. (ISBN: 1-886778-16-7).

Inspired lunatic James Morrow concludes the divine trilogy he began with *Towing Jehovah* (reviewed here in November 1994) and *Blameless in Abaddon* (January 1997) with **The Eternal Footman**. The title refers to an image of death in T. S. Eliot's "Love Song of J. Alfred Prufrock," the attendant who holds our coat and snickers, the servant who rides behind us all our lives despite all the efforts of religion to dispel him. The tale begins when God's Corpse disintegrates at sea, most of the organs ascending into the sky and exploding messily. The skull goes into geosynchronous orbit over Times Square (and never mind that New York isn't on the equator). And Nora Burkhart is led by fate to a mysterious triad of inscriptions that assure her that we may be trapped in mistaken beliefs and the absence of God is god enough. Then her son falls ill with what will soon be a global plague: riddled with nihilism or death-awareness, inhabited by a doppelganger who can emerge to hold conversations, he deteriorates rapidly into paralyzed and oozing incapacity. God is dead, and humankind

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is doomed. As the plague spreads, civilization descends into chaos, with American Jews and Neo-Nazis fighting a war on the golf courses of suburbia (among other absurdities).

Black humor? Of course. That is one of Morrow's greatest strengths. But there is as well a gift for powerful metaphor. The famed sculptor Gerard Korty, who yearns to build a proper temple to the human spirit and mind, finds himself agreeing to carve a new pantheon for psychiatrist Adrian Lucido, who thinks he knows a way to drive death from the plague victims. His method even seems to work, though Lucido and his minions—in the manner of eons of priesthoods—turn remarkably self-indulgent.

Meanwhile, Nora is fighting to keep her son alive. She hears of Lucido's clinic in Mexico and vows to make the journey from Cambridge, Massachusetts, despite all the chaos in between. With the aid of some characters from the earlier books, including Captain Anthony van Horne, now master of a steamboat brothel instead of a God-towing supertanker, she succeeds, gets her son to Lucido, sees him apparently cured, and then. . . .

The salvation of the world, says Morrow, lies in "the West's great gift to the world, the miraculous faculty of rational doubt." Humankind must be rooted "in the here and now. . . . The given world [is] sufficient. To imagine otherwise [is] to be a mere tourist on this amazing planet when you could have become a citizen." And one of the greatest obstacles to acceptance of this simple truth is surely God, or belief in God, and the fear of death that motivates the former.

James Morrow is an astonishing writer. He is invariably thoughtful and thought-provoking, and entertaining in the process. It is perhaps no wonder that when I introduced an English professor at my college to his work, he soon wound up one of the students' favorite parts of the syllabus.

Don't miss this one, and if you haven't read the earlier books, hunt them out. You'll be glad you did.

One of SF's favorite myths has a lot less to do with Jehovah than with the maverick. Stories of independent researchers, backyard inventors, and lone-wolf entrepreneurs have been with us since the genre's birth from the pens of Mary Shelley, Jules Verne, and H. G. Welles. Robert A. Heinlein used the myth, as have Gregory Benford and Charles Sheffield, and many, many more.

There's some truth to it, as there is to any good myth, but one cannot help but feel it is a bit overdone. And Eric Kotani and John Maddox Roberts do nothing to redress the balance in Legacy of Prometheus.

The tale begins as glamorous Japanese journalist Sachi Sasano meets the plane of equally glamorous Texan entrepreneur Cash Carlson, who plans to beat the European consortium, the Japanese, and the American megacorps to building operational solar power satellites to save the world from energy starvation. First, however, he must deflect the schemes of the Third World ministates to use the UN to regulate and tax to death all private uses of space.

Thanks to his excellent security crew, headed by a Comanche named Parker, he survives an ambush on the streets of Manhattan. Soon thereafter, he offers Sachi a job, while her erstwhile lover, Jean-Claude du Mont, head of the European Space Enterprise, gnashes his teeth, dreams of restoring France to its right and proper position (with himself as its glorious leader), and engages ex-KGB thugs to bring Carlson down. But Carlson's Lone Star Space Systems is up and running, funded by the recovery of an ancient treasure galleon (located with such miraculous precision that the tabloids accuse Carlson of having alien help!) and advised by a mysterious figure known only as "Max." The launch

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complex grows in Brazil. Sachi pitches a would-be kidnapper over a high waterfall. Parker finds a traitor in the company and gets wind of those KGB thugs. Unexpected allies appear, and the race to an operational powersat narrows down to a matter of days and hours, with the Europeans and the American megacorps apparently ahead. "Not to worry," says Carlson. "They're too big. They're bound to make mistakes. The gods are on our side."

What else can that be but mythology? Optimistic and modern, technological and progress-oriented, as American as the Fourth of July. So deeply embedded in the SF culture that the book has even less suspense to it than most of its ilk. And really quite strangely antithetical to the myth commemorated in the book's title: the gods were not at all on Prometheus's side; he had to snooker 'em, and when they found out what he had done, they chained him to a mountaintop and sent an eagle to devour his liver every day for the rest of eternity.

Poul Anderson is both one of the last and one of the best of the Old Guard. He has been writing SF and fantasy for longer than I have been reading it, and he remains productive, creative, thoughtful, thought-provoking, enchantment-voiced, and blessed with a far more interesting and entertaining view of mythology.

His latest, **Genesis**, begins with a boy, Christian Brannock, gazing at the night sky and wondering, yearning. The boy grows up to be an astronaut and work on Mercury to trap the solar energy that will power the antimatter factories destined to produce starship fuel. He shows an affinity for the artificial intelligences with which he must work, and in due time he is invited to be one of the first to upload his mind into the computers. The technology is new, but it is destined to improve. So are the AIs, and eventually humanity exists only within the machines, not as virtual humans but as fragments, aspects, of vast gestalt minds that exchange thoughts at the speed of light and comprise in a very real way a Galactic Mind.

Brannock, as one of the first, is an aspect of the machine minds that first leave Earth for the stars. He is awakened and embodied again and again, copied and recopied. In a very real way, he achieves every dream of exploring space he had had as a child. Meanwhile, back on Earth, people are debating turning planetary—and people—management over to a stay-at-home AI, and Laura Ashcroft is the AI's exponent. In due time, she is uploaded into Gaia.

And a billion years later, the Galactic Mind realizes that Earth has only a few hundred thousand years to live before its sun destroys it. Should it be saved? The Gaia Mind has been reporting on events at the ancestral home, but there is a sense of concealment. Something is going on.

Brannock is awakened once more and sent home to investigate. When he arrives, he detects dissimulation, but Laura Ashcroft has also been awakened to be his guide. Love stirs, and he is successfully bamboozled until the clues mount and he finally penetrates Gaia's schemes.

The cover blurb refers to "Gaia's shocking and terrifying secret plans for Earth." I think I do not reveal too much if I say that those plans are far more shocking (though surely not terrifying) to the hybrid superminds of a billion years hence than they could possibly be to us, who must see them as superlatively—even transcendentally—optimistic.

And so is Anderson's vision of the future. He sees no human empires of the sort he limned in so many of his past stories (starring Ensign Flandry and Nicholas van Rijn, among many more). Here is something more in tune with the realities and potentials of which we have become aware in his lifetime, something surely more likely, and in its way as enchanting. Yet, he says, perhaps

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we need to take another shot at those grand old dreams of the most ancient mythologies. Think of his title, after all.

Ken MacLeod's *The Cassini Division* (see the November 1999 column) gave us a future in which the rich, the powerful, and the nerds had fled Earth's chaos for space and wound up at Jupiter, where they downloaded themselves into virtuality, became the "fast folk," and went mad. Their slaves, human minds—both records of the dead and copies of the living—bound to robot bodies, escaped through a wormhole to New Mars, ten thousand light years yonder. There they built a society that recognized artificially intelligent machines as persons and operated under the rules of libertarian anarchy (one for one and all for none, unless you can pay).

The Stone Canal is centered on New Mars, some time before the events of the other book. AIs are not yet recognized as persons, and therein lies the rub. As the tale opens, Jonathan Wilde is awakening on the bank of a canal on New Mars. With him is the "human-equivalent" machine Jay-Dub who just brought Jon to life. Meanwhile, back in town, Dee Model, a gynoid robot wearing the cloned body of Jon's long-dead wife, has attained consciousness and made a run for it. Her owner, David Reid, New Mars's ruler inasmuch as it has one, wants her back, but she evades the repo men and finds allies who help her claim independence. But Reid knows how she woke up—a machine fed her computer the appropriate codes. That machine, of course, was none other than Jay-Dub, whose mind is that of Jon Wilde! Next stop, court.

Once upon a time, back in 1975 Glasgow, Jon and David were good buddies, drunk on ale and communism and love and jealousy. Jon became a pro-space anarchist, David an industrial mover and shaker, and their paths kept meeting as the world moved toward chaos. Half the novel concerns their history, the politics of an Earth in flux, and the outward flight from chaos led not by Jon but by David.

How did Jon become Jay-Dub? What is Jay-Dub's goal? Does Dee Model go back to her master? Do the millions of dead whose minds and tissue samples are in storage ever get brought back to life? Can the "fast folk" be awakened safely, so that their madness does not destroy another world?

Read the book. MacLeod's a bestseller in England (this one appeared there in 1996), and he deserves the wider audience available here.

And watch for his name in future.

Neal Stephenson has done some nice high-tech SF (I reviewed *Snow Crash* here in October 1992 and *The Diamond Age* in August 1995). He's also very familiar with computers, having used them since the days before the graphical user interface made famous by Macintosh and Windows flooded the marketplace. That is, he remembers that famous command line, preceded by the blinking A:> that demanded you tell the computer just what it was supposed to do. There were no icons then, no mice or trackballs. You really had to know your onions. In the Beginning Was the Command Line.

Then, says Stephenson, Wozniak and Jobs said, "Let there be the Mac," which was promptly imitated by Microsoft, and now operating systems are peddled like automobiles, even though they are remarkably intangible things. Indeed, Stephenson plays a bit with the comparison: Apple is the dealer in sleek European sports cars, hermetically sealed and unrepairable. Microsoft, which started off selling cheap, imperfect but workable, repairable bicycles, now offers equally imperfect station wagons. Meanwhile, across the road the Linux dealership is trying like mad to give away M1 tanks that never break down, use no more fuel than a subcompact car, and can drive a hundred miles an hour

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across rough country. There's also the BeOS batmobile dealership.

Stephenson has tried them all, and he has vigorous, witty opinions on them. His book is a pleasure to read, and it makes me want more than ever to lay my hands on a spare machine so I can test drive that Linux tank.

There are some defects worth noting: Apple did not invent the Mac desktop with its windows, icons, and mice. That credit properly belongs to Xerox PARC. And though the automobile steering wheel is indeed an admirably simple "operating system," it was not invented from scratch to meet the needs of the new technology. The first cars had tillers (yes, like boats), and the steering wheel was of course modeled on ships' wheels. He grants that technology is layered, each new system built upon and with the fossilized bones of its predecessors, but he is not truly aware of how far down the strata go.

But never mind—this one is worth your money and time.

Frank M. Robinson has been a well known writer and editor for many years, and much of his activity has been in science fiction. He is thus an excellent man to put together **Science Fiction of the 20th Century: An Illustrated History**, a coffee-table survey of everything from Frank Reade, Jr., through Wells and other pre-Gernsback SF, to the dawn of the SF magazines and onward to modern times. The text is cogent but brief; the great strength of the book is a profusion of magazine and book covers and film art, all reproduced in full color, as well as its assurance that the SF century—which began with horse-drawn buggies still on the streets and ended with space shuttles in orbit—may be dying, but ahead of us lies the SF millennium, no longer fiction but life.

Ken Croswell's **Magnificent Universe** is a coffee-table compendium of astronomical photographs, with a few paintings and charts. It begins with Earth itself and moves through the Solar System to the great beyond of galaxies and clusters. The text provides a compact introduction to astronomy, although most "readers" will surely pay more attention to the stunning artwork, much of which comes from the Hubble Telescope, Galileo, Viking, and ground-bound telescopes.

A beautiful book.

You've got classics by L. Sprague de Camp, Ambrose Bierce, George Alec Effinger, and more. You've got brand new stories by the likes of Gene Wolfe and Esther Friesner. You've got Elvis and dragons, aliens and gangsters, demons and wizards. You've got something for everyone, smiles and giggles and guffaws, in **The Mammoth Book of Comic Fantasy II**, a mammoth package edited by the renowned Mike Ashley. What more can I say?

NOTABLE REISSUES

"Bison Books" is an imprint of the University of Nebraska Press (312 North 14th Street, P. O. Box 880484, Lincoln, NE 68588-0484; (402) 472-3581) dedicated to classic works of science fiction and fantasy. Among its offerings are Philip Wylie's and Edwin Balmer's **When Worlds Collide** (1932, 1933), including the sequel **After Worlds Collide** (1933, 1934), in which a runaway planet hurtles toward Earth; J. D. Beresford's **The Wonder** (1911), in which a superchild is born in England; and Mary E. Bradley Lane's **Mizora: A World of Women** (1880, 1881), in which a fleeing Russian noblewoman discovers a world without men. All three are of considerable interest to anyone concerned with the history of SF, for all three have spawned imitations. They are also good enough as stories to be fond memories to those of us who first encountered them many years ago—as I did *When Worlds Collide*—trolling the shelves of a town library for another SF fix.

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Gryphon Books brings us Jack Williamson's **The Stone from the Green Star**. Serialized in 1931, this tale has never seen book publication before, at least partly—says the foreword by Philip Harbottle—because Williamson thought "it had nothing new to say" and "its picture of the future looks pretty childish now." Yet it was one of the tales that founded the adventure fiction core of SF, and as Harbottle says, when one reads it, one sees powerful parallels to *Star Wars*.

You are readers. Perhaps you've been telling your friends that the most blazingly modern of Hollywood skiffy is blatantly derivative of stories written in the 1930s. If so, now you can show them.

In its continuing effort to bring the classics back into print, NESFA Press offers Rings, a collection of four novels by Charles L. Harness. Three of the novels—*The Paradox Men* (1953; Harness is best known for this novel and *The Rose*, available in NESFA's *An Ornament to His Profession*, 1998), *The Ring of Ritornel* (1968), and *Firebird* (1981)—are old. One—*Drunkard's Endgame*, involving the return of a fleeing spaceship to a long-dead Earth—appears here for the first time though its style suggests that it was written many years ago.

In the introduction, George Zebrowski notes that Harness has long been esteemed by fans for his "wit, intelligence, and ingenious invention." "His stories shine from within, with a strange, glittering pleasure of bitterness." Harness himself notes that he was strongly influenced by A. E. van Vogt, but with his technical background (he was a patent lawyer for thirty-five years) he always made much more sense than van Vogt. □

Chat Online
with your favorite authors!

***Asimov's* Mother's Day** — **May 9 @ 9:00 p.m. EST**
Kristine Kathryn Rusch, Susan Casper, Melanie Tem, and M. Shane Bell discuss the newest anthology from Ace Science Fiction.

SF and Baseball — **May 23 @ 9:00 p.m. EST**
Rick Wilber, Michael Bishop, Karen Joy Fowler, John Kessel, Edo van Belcom, and James Van Pelt

June Romance — **June 13 @ 9:00 p.m. EST**
Catherine Asaro, Tom Purdom, Diane Turnshek, and Jennifer Dunne

Go to **www.scifi.com/chat** or link to the chats via our home page (**www.analogsf.com**). Chats are held in conjunction with *Asimov's Science Fiction* and the Sci-fi Channel and are moderated by *Asimov's* editor, Gardner Dozois.

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BRASS TACKS

Dear Stan:

Like most of *Analog*'s readers, I started the December issue by reading your editorial, "Hardly Ever Say Never." I want to point out that the first mention of replacing live actors with computer-generated images indistinguishable from the real thing was (as far as I know) in my novel, *The Star-crossed*, published in 1975. I also used the concept in a Sam Gunn short story, "The Long Fall," published in 1991.

BEN BOVA

Dear Stan:

Congratulations on the anniversary! I've been reading *Analog* and its predecessors for over fifty years and my very favorite story in all that time is Hal Clement's *Mission of Gravity*. To find both his new story "Under" *and* the bio material you included was a treat indeed.

Having said that, and recognizing that you urged that people aggravated about the 2000 hoopla "put down that pen," I still want to pass along a simple thought.

"New millennium/new century, 2000 or 2001" is not a matter of preference or choice, it's a matter of fact. If we think of 2000 not as "two thousand" but as "twenty hundred," it makes it much clearer that 2000 is the last year of the twentieth century, not the first year of the twenty-first. As to your comment that "the 'Twentieth Century' is almost universally understood to mean 'those dates beginning with 19,' i.e., 1900-1999 . . ." I, at least have never thought of it in those terms. In fact, I was born on January 1, 1929, and for many years I've been saying to people that I want to live to at least my seventy-second birthday (that is, until January 1, 2001), in order to see if 20th Century Fox changes its name to 21st Century Fox! However, they pre-empted that idea several years ago, so now I'm just looking forward to the new century and the new millennium, both of which occur on that date.

JACK E. GARRETT
Monroe Twp., NJ
lmpacl@aol.com

The facts are not in dispute: the First millennium A.D. unarguably ends at the end of 2000. But I think far more people will continue to regard the changing of four digits as more of a milestone than the changing of one. Also, you are atypical; most people do regard "the 1900s" and "the twentieth century" as synonymous, and doing so is so convenient that they will almost certainly continue to do so. So I think it's time to stop wasting any more breath or ink "arguing" about what is really a non-issue.

Dear Stan:

In his Biolog of Mr. Hal Clement, Jay Kay Klein waxes eloquent on Mr. Clement's devotion to rigorous hard science in his stories. Will he or Mr. Clement please explain what kind of "fire" can exist in the hydrogen atmosphere of the planet Mesklin?

JACK PAGE

Hal Clement replies. . . .

My assumption for Mesklinite biochemistry had the anabolic tine of the ecology fork—the "plant" duty—using energy to form unsaturated hydrocarbons and/or more complex organics; the catabolic organisms—animals—got

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their energy by hydrogenating the plant material again. Seemed qualitatively sound; I worked out several examples quantitatively using data from the CRC handbook. The most encouraging comparison was between glucose-oxygen to water-carbon dioxide and acetylene-hydrogen to methane, which had surprisingly similar energy yields per gram of, respectively, glucose and acetylene. I could do the calculation again, but am feeling lazy, and certainly couldn't find the original paperwork after forty-seven years. If it's any help to anyone, I remember I used heats of reaction—delta F—not the free energy changes, delta G. The difference seemed too small to worry about.

Carrying the same idea to combustion may be a little shakier. I naturally assumed the existence of appropriate enzymes in the animals for the saturation reactions. I did mention in the original story that "fires" involved sprinkling meat juices on the "wood" to encourage the reaction. Since such "enzymes" could hardly be expected to reach really high temperatures without being denatured, one has the vocabulary question of whether the gravy should be considered a catalyst or a reactant.

I never regarded a fire on Mesklin as involving flame and smoke (sorry, Kelly [Freas], but I didn't know what scenes you would be using for "Under"), but more like warm coals. The word *warm* of course translates to *extremely hot* to Mesklinites. I admit I did not calculate temperature factors, except to come up with a rough idea of the size of hot air balloon needed for what seemed a reasonable lift—no rates of convection from firebox to balloon, no loss of heat estimates through balloon skin. If anyone wants to try these and comes up with really surprising results, he or she has my blessing for writing another Mesklin story about it. After all, there is a lot of time undescribed during the development of the flying *Brees* . . .

HAL CLEMENT

Dear Editor,

Ben Bova has been writing SF for a long time; Long enough to know that a story needs to be internally consistent. "Greenhouse Chill" is not. Tim and Hawk are on an ocean caused by the melting of ice caps. There ain't no other source for all that water. Ben Gunn shows them satellite feeds of an enormous ice cap approaching from Canada. Enormous ice cap? Sunken U.S.A.? Can't have it both ways. If you want me to suspend disbelief and accept your basic premises, the science *has to be* logical. This isn't. Campbell, Asimov, et al., wouldn't have bought the story. You shouldn't have either.

MAYNARD J. HIRSHON
Seminole, FL
maynardh@aol.com

The author replies. . . .

You raise a valid point. It might be possible to have extensive glaciers covering much of Canada and still have the Mississippi valley flooded; it's a matter of timing and land subsidence from the weight of water (or ice) covering it. If the Greenland and Antarctic icecaps melted entirely, sea levels would have risen high enough to perhaps allow a significant reglaciation in the northern hemisphere without lowering sea level so far that the Mississippi valley would be drained.

BEN BOVA

Dear Editor,

James Gunn's "Pow'r" in the January 2000 issue is a good yarn, but contains a technical glitch that I find quite annoying. In their transatlantic flight, the characters were transported in an airplane propelled by superheated steam, energized by broadcast power. This imposes a tremendous weight penalty on the aircraft to carry all that water. It would be much more efficient just to employ standard gas turbine engines and heat the input atmospheric gas in the "combustion" chamber with the broadcast

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power, or, even more efficient, drive the turbine fans electrically. That would allow backup chemical fuel to be used very readily in case of power outage. After all, modern aircraft turbine engines employ high-bypass fans for propulsion, getting only a small portion of the total thrust from the hot gas exhaust.

BILL WOODS
Redmond, Washington

The author replies. . . .

I hadn't considered the weight penalty of the water, and your suggestions make a good deal of sense. I'll incorporate them if I revise for novel publication. Sometimes what seems like a good irony (a return to steam power) won't work in practice. I guess I should have included an engineer as well as a physicist among my consultants.

JAMES GUNN

Dear Editor:

I have subscribed to *Analog* for many years in the hopes that I will find a story that really gets to me. Many have come close. None has affected me like "Soapbox Cop Blues" by Stephen L. Burns (January 2000). Its ending elicited tears. That is not easy for me to admit. Being aware of the huge amount of hate and intolerance espoused by a few misguided individuals on the Internet, it is good to feel that there is a possibility of fighting back.

The freedoms, including free speech, which Americans enjoy and for which many have died to protect, should imply some responsibility as well. That may seem somewhat idealistic, but if more people felt that way, perhaps there would be less intolerance on the Internet. It would not trouble me in the least to know that, eventually, something like the "Soapbox Cops" would exist. Like these people in your story, they would be compelled to operate within the law while on duty, but would still be able to exercise their freedom of speech on their own time and would be willing to.

JOHN COUTURIE

Dear Editor,

The patent system, as John D. Trudel states in "The Patent Wars" (January 2000), was an American innovation that helped promote inventions during the industrial era. However, it is much less clear that it continues to be a useful structure in the current age of computers and software. A case can be made that the patent system actually impedes innovation rather than promotes it. To cite a few examples:

U.S. Patent 5,860,073 (1999), owned by Microsoft, claims protection on the use of style sheets in Web pages to format the output. Style sheets were actually invented at least five years earlier by the W3 Consortium, but this patented form applies to their use in Web pages where the text is "poured into" the document after the style sheet is applied. Probably any use of style sheets on Web pages whose text is generated dynamically by scripts would fall under this patent.

U.S. Patent 5,838,906 (1998) covers the use of embedded programs in Web pages, apparently including all current uses of applets and plug-ins, though these were in use at least as far back as 1995, and proposed publicly by a number of people earlier than that.

U.S. Patent 5,806,063 (1997) covers the use of date windowing to solve the Y2K software problem. If you use program logic that interprets two-digit years less than 50 as 2000+yy, and greater numbers as 1900+yy, then you're infringing this patent. This technique was being used and published by a wide variety of independent people and companies as early as 1975.

U.S. Patent 4,751,669 (1984), owned by Wang, was originally for a form of videotex, but was used in an attempt to make Web browser makers pay royalties for such features as the "Save As" menu command and the bookmark feature.

U.S. Patent 4,528,643 (1984), originally for a system of delivering custom-made music tapes and CDs through elec-

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tronic transmission to a sales kiosk, was used in an attempt to get royalties from all Web-based e-commerce sites which made products such as software and music available for download.

Then, there's the infamous GIF LZW patent, where a popular graphic format believed to be open-standard and royalty-free was found to have a patented compression technique owned by Unisys, who now wants royalties on software that reads or writes this format (the most common graphic format on the Web). In this case it's not so much the patent itself that's unreasonable, but the fact that it's snared users of a common file format which people must keep using for compatibility's sake.

Such overblown claims have become distressingly commonplace, and are motivated more by trying to milk a profit from the sudden success of the Internet than by trying to create anything new or innovative. While the courts often dismiss these claims, it can cost a lot of money to fight them, and the advantage is to bigger corporations, not to small businesses or individual inventors. I don't know if the particular legislation Trudel criticizes will help in such cases, but I do feel that some reform of the system is desirable.

DANIEL R. TOBIAS

Dear Dr. Schmidt,

"The Patent Wars" is over the top. The U.S. patent system does differ from the systems in the rest of the world in various ways (and on the whole the rest of the world thinks the U.S. system is out of step and should be changed). But as with any discrepancy in different national standards, there are things to be said for both sides.

To deal fully with his assertions would take an article as long as his, so maybe I can just pick a few points.

"... during the founding of the United States our ancestors invented the notion of patents," and "Our patent system [is] unprecedented and unique in the world ..." That's news to the UK. The system of granting of Letters Patent for inventions was explicitly confirmed a century and a half earlier by the Statute of Monopolies of 1624.

"Inventors were guaranteed a limited monopoly in return for providing society with a detailed cookbook of how to replicate their inventions," "The United States patent system is still unique in the world. Its concept was brilliant. In exchange for fully disclosing his inventions, an innovator would be awarded a limited monopoly ..." and "... a unique characteristic of the U.S. patent system is full disclosure." Again, most countries require and publish a full disclosure. In the UK, for example, the requirement of full and honest disclosure has long been established, and the full sequence of the specifications of all IJK patents from 1624 onwards is published and readily available.

"Ours in generally agreed to be the best patent system." I doubt whether that is the consensus view outside the U.S. Commentators from the U.S. may feel that way, but, like most people, they tend to prefer the system they were brought up with.

In most countries, a patent can be granted to a company; in the U.S., a patent must be granted to the inventor personally. I suspect that Trudel regards this as a significant advantage of the U.S. system. But this difference is in fact largely superficial. Most U.S. companies have contracts of employment which give them the exclusive rights to employee inventions, typically for "one dollar and other valuable consideration." (There's something to be said for the German system of compulsory employee inventor compensation.)

Trudel trivializes the problem of "submarine" patents by defining them as those which remain submerged for over 20 years, rather than say 10 or even 5 years. If I invent something, when can I be confident that I can invest in a factory to make it without the risk of finding

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myself infringing somebody else's patent; some unknown period which may be several years?

"One of the undiscussed weak links in this argument [about "submarine" patents] is how and why the inventor could . . . delay his patent." When the U.S. PTO issues an Official Action, the term for response is relatively short. But most patent attorneys know that it is usually possible to respond in such a way that a further Official Action is issued, and if you want, you can often extend the process considerably.

And what of drug companies who, as Trudel says, would like to delay grant to effectively get a longer term? Even under the old U.S. system, that was at the mercy of chance. In Europe, we have a special system of extension-of-term for drugs. Why doesn't Trudel propose the adoption and improvement of that system, or of the old British system of extensions of up to five or ten years on the grounds of exceptional merit and/or inadequate remuneration?

"Prior user rights," "18 month publication," and suchlike are difficult matters. If I invent something and use it for years or decades, even in secret, should a later independent inventor be able to stop me when he gets his patent? And publication at the 18 month point at least tries to solve the problem of submarine patents.

I don't know anything about the various peculiar ways and levels of deception involved in the attempted and actual amendment of the U.S. patent system. But I am inclined to assume that Trudel's account of that is on a par with his other comments, and I therefore take his comments with a strong pinch of salt.

M.G. HARMAN
United Kingdom

Dear Editor,

I read with interest Mr. Trudel's article. As a former Examiner (I left the office in 1996), registered patent agent, and law school graduate, I found the article to be an accurate representation of the state of the patent system in this country. Only a few minor errors were noted which are really not worth correcting.

However, Mr. Trudel did leave out one important factor contributing to the demise of the patent system in this country, and that is the apparent systematic and incremental decline in the quality of examinations made to patent applications over the last ten years.

It is important to provide a quality examination to prevent granting patents to inventors for inventions which have already been patented or are otherwise already in the public domain. If a patent is granted on an invention already in the public domain, that effectively removes that invention from the public domain and puts it in the hands of the so-called inventor, at least until the patent is successfully challenged in court.

The courts of this country give patents a "presumption of validity" which means that the burden is on the alleged infringer to prove that the patent is not valid. This often results in patent holders forcing accused infringers to pay royalties—until they finally pick on an accused infringer who is willing to fight the patent in court.

The cost of patent-infringement litigation is much greater than the cost of obtaining a patent, so large corporate entities with deep pockets have an advantage in court. Thus, if a patent can truly be presumed to be valid upon issue, i.e., if the quality of examination was much greater than it is today, it would result in a significantly less litigation, and a leveling of the playing field between small inventors and large ones.

It is in Big Business' interest to lower the quality of examination because it, at the very least, tilts the balance of patent adjudication in their favor, and at most makes it easier to steal ideas from small companies and individuals.

Most attorneys, agents, examiners,

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and inventors would agree that the quality of examination has steadily declined. This decline is a result of many factors, including inadequate time given the examiner to review the case and search for prior art, inadequate examiner training, inadequate materials, and inadequate tools.

Recently, examiners were so upset at the quality of tools they were given that they signed a letter of complaint and sent it to Congress directly. The rumor is that about 400 examiners have signed it, about 20 percent of the corps (or 33 percent of the corps that regularly uses online patent searching). This letter was mentioned in an article in the Washington Post: *http://www.popa.org/pdf/wpost-111999.pdf*

LEONARD HEYMAN

The author replies...

I am very thankful to *Analog* for giving coverage to my topic, and to the many readers who have contacted me for information. I'll start by saying that the letters of Mr. Tobias, and especially Mr. Heyman are of high value. To a large extent, I agree with them. I don't agree with Mr. Harman, but his letter adds to the debate.

Sadly, the open debate that the Nobel laureates requested on the legislation to change our patent system never happened. There were perfunctory hearings on one of the early bills, HR 3460, in 1996. Those who spoke were opposed to the bill, but it died in committee, and there were no more open public hearings on this legislation. I regret to report that it has now passed into law as S. 1948. The foreign lobbyists prevailed.

S. 1948 passed late at night without debate. It was tucked into the 2,000-page budget bill, and passed as the last item before Congress adjourned for the holidays. Details and a link to the text of the bill are on *www.trudelgroup.com*.

As the above letters have noted, my article, though lengthy, did not—could not—discuss every aspect of the assault on our patent system. I focused on the attempts to sell off our system and to block innovators from getting patents. There has also been a parallel internal attack to dumb-down the system and invite its corruption.

Yes, there is a growing body of evidence that junk patents are being used to mercilessly harass small software firms. No wonder that some scream in pain and wish that patents didn't apply.

Still, the real issue is not software, it is junk patents. A junk patent granted to a large cartel invites legalized extortion. This may get worse: I got a note that a large Japanese firm is actually filing patents on foods like Indian curry and pizza. One reader, worried about genetic patents, wondered if he might have to someday pay a fee to Hitachi (or whomever) for having a child. I laughed and said, "No." Now that I have been reading the new law and pondering the consequences of a Technology Czar without oversight (Bruce Lehman repeatedly said he viewed his job as "to regulate technology"), I'm not so sure.

I've been out on the barricades fighting to save the system. I will leave it to others closer to the patent office to report how the cadre of qualified, loyal examiners has now been replaced by uncaring, inexperienced worker-wonks, militant minorities, and temps, and the bizarre results. That topic alone may warrant a Congressional investigation, assuming that we can still find insiders who dare to testify, and that Congress and the agencies that police government corruption still have purview over the PTO. (They may not.)

Our nation owes a debt to the old-school patent examiners. They did a difficult job well, and the PTO was the only government agency that had never had a scandal.

That leaves us with the "over the top" Brit., Mr. Harman, and his lengthy dialog which reminds me why so many people loathe attorneys. He cites facts, but

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much of what he argues is irrelevant or off just enough as to confuse rather than enlighten.

For example, many of the words he puts in my mouth are not what I said. For example: "Trudel trivialized the problem of submarine patents by defining them as those which remain submerged for 20 years. . . ." and ". . . drug companies, who, as Trudel says, would like to delay grant to get a longer term." I never said either of those things, and will not bother to repeat what I did say.

Mr. Harman, though some recent history may lead you to think otherwise, I can assure you that not all of America's leaders or spokespeople are pathological liars.

The person I cited for saying that we invented our form of patents, President Abraham Lincoln, has gone down in history as "Honest Abe," and is revered as such. He was typical of our most respected leaders. George Washington is beloved as the child who said, "I cannot tell a lie." Your colleague and countryman, Mr. Tobias, accepts that our patent system was "an American innovation," as do most. Likewise, most accept it as best, not for aesthetics, but because our firms do so well at capturing new, high growth industries. The Japanese attribute this singularly to our patent system.

The best point of Harman's letter is what he misses. It is what we call "the American dream" and it is clear that he has not a clue as to why a private citizen like myself would expend effort defending our patent system except for possible self-interest. I have traveled and done business in Europe and Japan, and, though they have much to admire, they have no equivalent.

In Europe or Japan, with very rare exceptions, the best a person can do is to aspire to work for a large company. If they keep their noses clean and go along, they may eke out an adequate life. Here, if we don't like things or can think up a better way, we can start a company and prosper. Hence Apple, Netscape, Intel, Hewlett-Packard, Microsoft, Amazon and the dot-coms, and on and on. That's why it's been the American Century.

That century ends on March 29, 2000, when the new law goes into effect. What now do we tell our grandchild, the young girl playing on the computer? "Too bad, kid. There's no chance for you to be a Bill Gates or a Kim Polese; it's not your century. Maybe you can get a job writing code for the government." Ugh!

JOHN D. TRUDEL■

No man who depends upon the caprice of the ignorant rabble can be accounted great.

— Cicero

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UPCOMING EVENTS Anthony Lewis

2–4 June 2000
CLAVECON (Theme: Legal Aspects of SF) at Ramada Inn, Fanwood, NJ. Fan Guest of Honor—William Willis, Jr., Esq. Registration—$20. Info—Clavecon, Box 10734, New Brunswick, NJ 08906. email—<clavecon@hotmail.com>.

9–11 June 2000
CONSORTIUM 2000 (Houston area SF conference) at Radisson-Hobby Airport, Houston, TX. Guest of Honor—Elizabeth Moon. Registration—$25 until 31 May 2000, $30 at door. Info—ConSortium, c/o Horizon Games (218) 286-9282. email—<horizon@flash.net> URL—<www.horizongames.com/consortium>.

28 June–2 July 2000
SFRA 2000 (Academic SF conference) at Comfort Inn, Cleveland, OH. Guest of Honor—Richard A. Lupoff. Registration—$90 until Easter, $100 thereafter, $125 at the door. Info—Joe Sanders, Dept. of English, Lakeland Community College, 7700 Clocktower Dr., Kirtland OH 44094. email—<joesanders@aol.com> URL—<www.sfra.org/2kconfab.htm>.

29 June–2 July 2000
DRAGON*CON 2000 (media-oriented SF conference) at Hyatt Regency, Atlanta, GA. Guests—Lynn Abbey, Kevin J. Anderson and Rebecca Moesta, Terry Brooks, Nancy Collins, James P. Hogan, Katherine Kurtz. Registration—$60 until 15 May 2000, $75 at the door. Info—Dragon*Con 2000, Box 16459, Atlanta, GA 30321-9998. URL—<www.dragoncon.org>.

31 August–4 September 2000
CHICON 2000 (58th World Science Fiction Convention) at Hyatt Regency, Chicago, IL. Guests of Honor—Ben Bova (former editor of *Analog*), Bob Eggleton, Jim Baen, Bob & Ann Passovoy. TM—Harry Turtledove. Registration—$150; supporting $40. [These rates are good through 30 April 2000; they may go up again. These are the latest posted rates as of the time this column went to press.] This is the SF Universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info—Chicon 2000, Box 642057, Chicago, IL 60664. email—<info@chicon.org> URL—<http://www.chicon.org/>.

26–29 October 2000
WORLD FANTASY CONVENTION 26 at Omni Bayfront, Corpus Christi, TX. Guests of Honor—K. W. Jeter, John Crowley. TM—Joe Lansdale. Registration—$105 Info—WFC 2000, Box 27277, Austin, TX 78755. (512) 835-9304 (voice), (512) 835-7637 (fax). email<fduartejr@aol.com> URL—<http://2000.worldfantasy.org>

Convention runners: If your convention has a telephone, FAX, email, or Web page URL, please let us know so that we can publish this information.

Convention attenders: When calling conventions for information—do not call collect and do not call too late in the evening. It is best to include a S.A.S.E. when requesting information.

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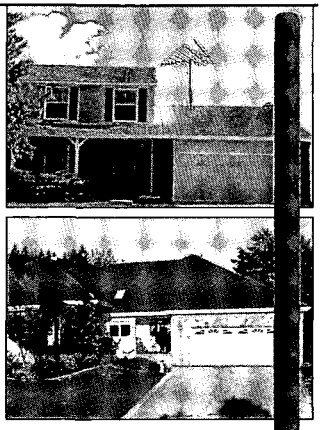
TECHNOLOGY UPDATE

Stealth antenna hides under gutters but performs like big ugly antennas

The new Max Antenna by GE is the low-profile, high-gain way to get flawless reception of broadcast signals without expensive installation.



by Hope Chapman

The Max Antenna by GE is the ultimate TV antenna system.

Electronic engineers agree—your television is only as good as the signal it receives. Unfortunately, antenna design has not kept pace with improvements in television quality and the features available. Both cable and satellite television systems have spent a great deal to improve the quality of their transmission, but they can be extremely expensive, they aren't available in all areas and may not provide access to local TV stations. Luckily, there is a new antenna from GE that will provide breakthrough performance without making your family room look like something out of the fifties.

Clear alternative. The Max Antenna series from GE uses a revolutionary electromagnetic design to maximize installation flexibility and yield longer range reception of off-air VHF and UHF signals. Unlike a conventional dipole antenna, the Max Antenna can receive signals in both vertical and horizontal planes with minimum cross-polarization loss. This design allows for the first low-profile antenna solution that provides numerous installation options.

Superior components. The key to the superiority of this antenna is its ingenious use of the latest electromagnetic technology—providing high gain and full channel coverage as well as the greatest amount of mounting flexibility. First, the antennas were designed around a wide band element to achieve the greatest amount of gain in a relatively small space. Next, an amplifier and matching network was designed to enhance the reception of weak signals. This amplifier also adds very little distortion to the strong signals, giving it a balanced amount of gain. A filter on the amplifier board will allow for good matching between the antenna and amplifier. Special attention was paid to design an antenna-amplifier combination that would be completely compatible with the new digital transmission format. It has been designed for strong signal distortion rejection and a low amount of noise. It is omnidirectional and requires no adjustments, orienting or fine tuning during use. You simply install it, set it and forget it.

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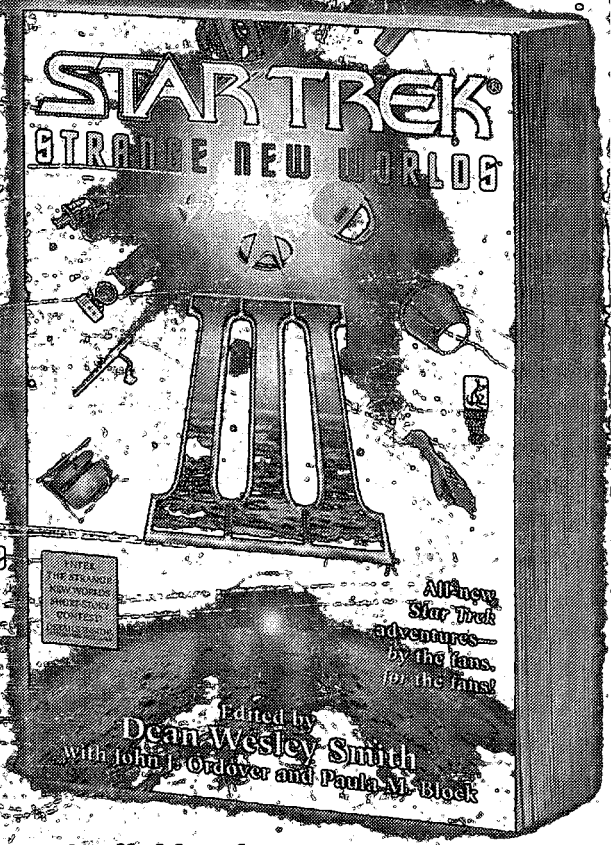
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